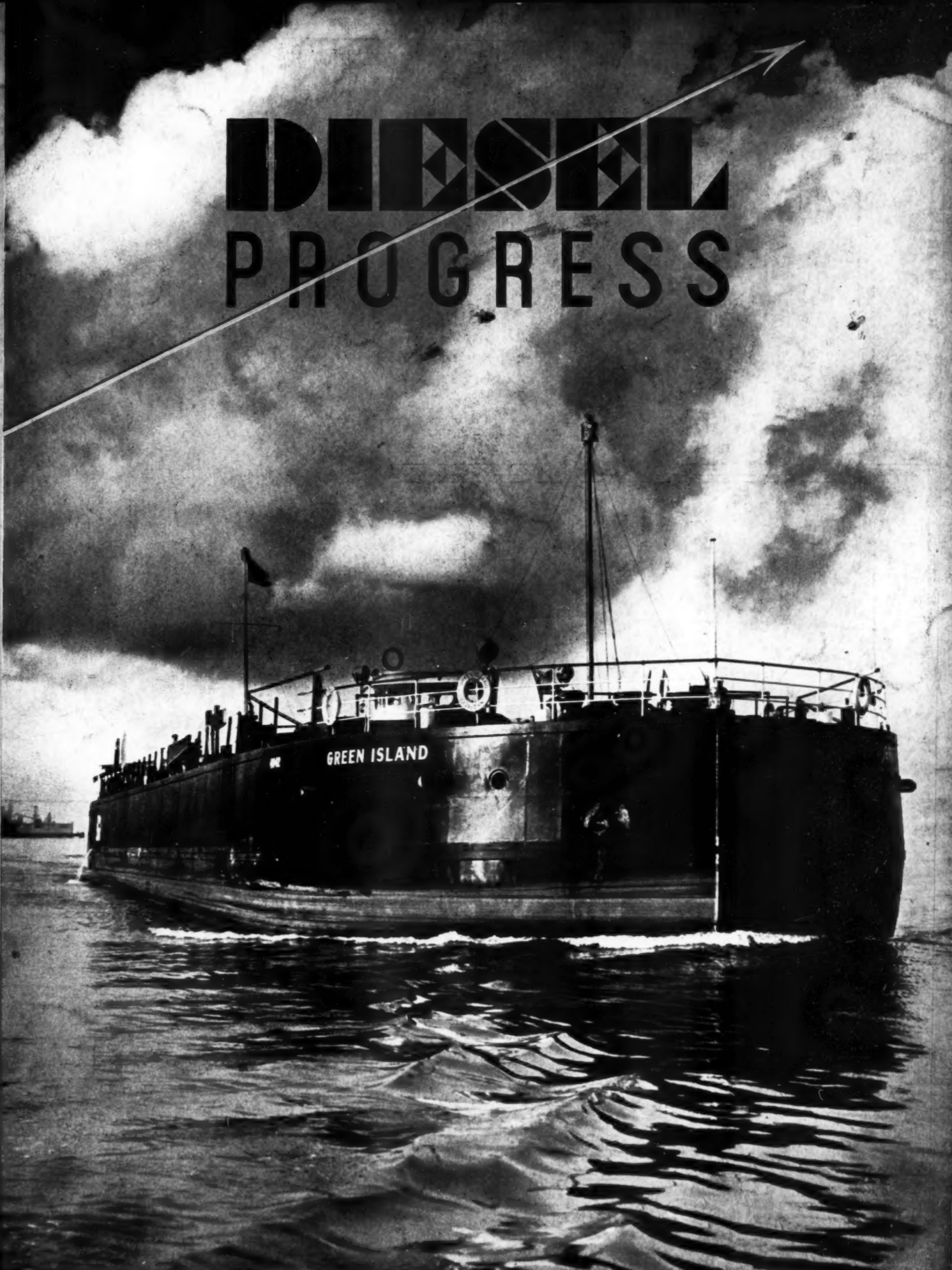
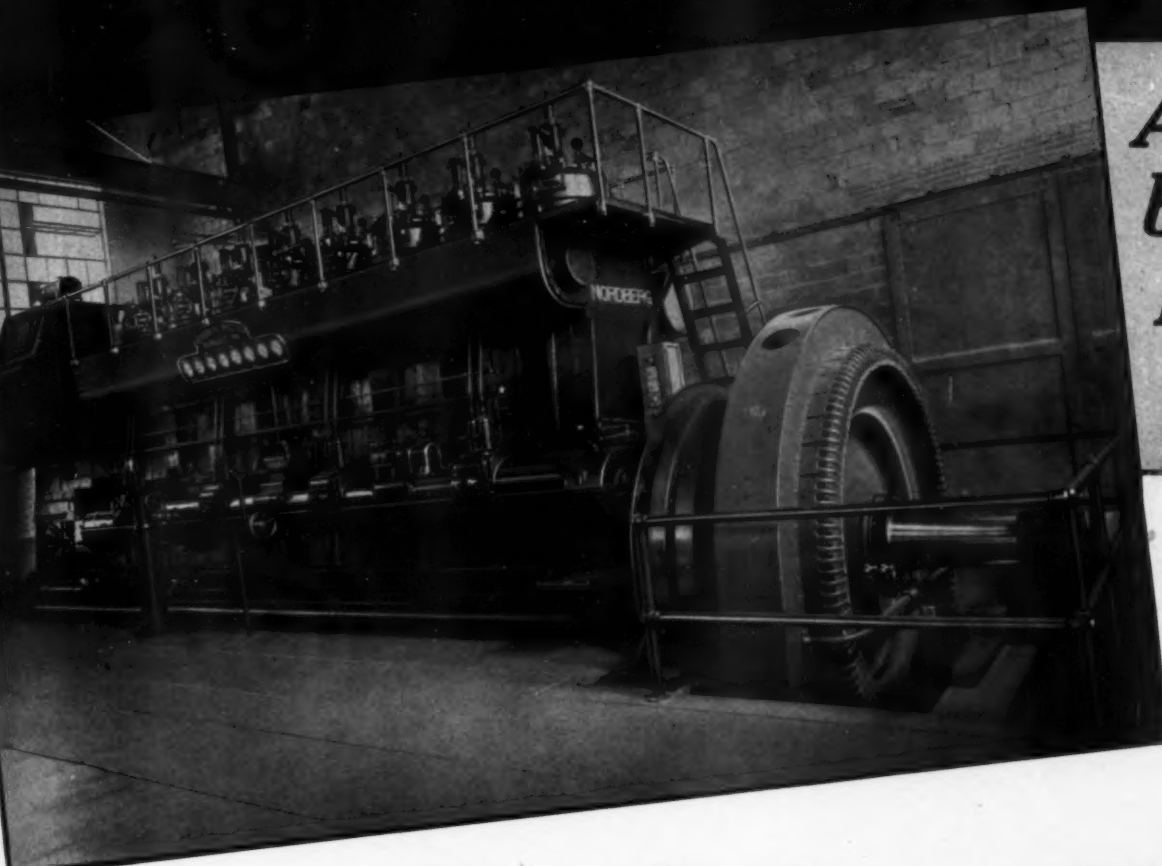
IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR



AUGUST, 1937 CIRCULATION OF THIS ISSUE—IN EXCESS OF 11,000 COPIES 25c

DIESEL PROGRESS for August, 1937. Volume III. No. 8. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Possessions $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U. S. A., 50 cents for all other countries.

Another outstanding Diesel contribution by NORDBERG



A dual fuel burning, full Diesel for both oil and gas

CITY OF LUBBOCK, TEXAS
An eight cylinder, 1500 horsepower, two cycle, crosshead constructed, Nordberg Dual Fuel Burning, Full Diesel Engine, operating on natural gas and convertible to oil operation.

Power Cost Reduced 46 Percent

Once more, Nordberg has made an outstanding contribution to the field of Diesel power. It is now possible to secure an engine operating on the full Diesel principle and which is convertible to burning either oil or gas fuels. When burning the latter, the economy is decidedly better than that of ordinary gas engines. For operation on either oil or gas, no changes in fuel valves, pistons, heads, or other major engine parts are necessary. The gas fuel is injected through the fuel valves and fired by the heat of compression, just the same as the oil.

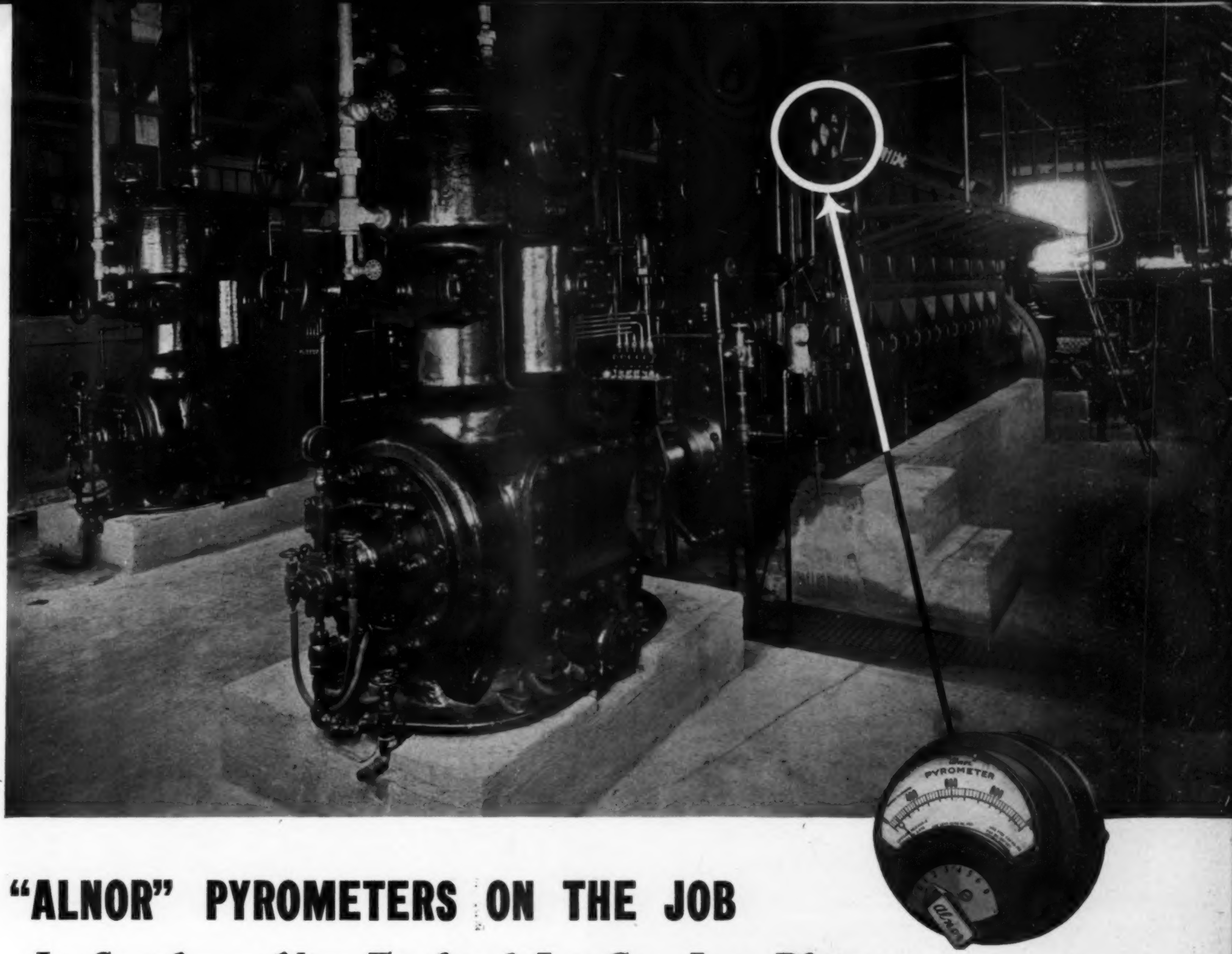
The engine shown above has been supplying municipal power at Lubbock for about one year. A comparison of the cost of producing power with Nordberg oil and gas burning Diesels in the Lubbock Plant shows a reduction in fuel cost of 46 per cent in favor of gas. Where natural gas is available, this Nordberg Dual Fuel Burning Diesel Engine has many attractive advantages. When operating on either fuel, the high efficiency of the full Diesel is always obtained.

NORDBERG MACHINERY

Bulletin 77 describes this Nordberg Convertible Gas and Oil Diesel Engine, Write for it.

NORDBERG MFG CO., MILWAUKEE

NEW YORK	WASHINGTON	CLEVELAND	KANSAS CITY	DALLAS	LOS ANGELES
60 E 42nd St.	Barr Bldg.	318 Rockefeller Bldg.	3560 Broadway	3801 Potomac Ave.	Subway Terminal Bldg.


PYROMETER

FARREL GEARS

DRIVE FORD FREIGHTERS

IN adding the *Green Island* and *Norfolk* to its canal, river and coastwise fleet, the Ford Motor Company has produced two Diesel-gear freighters, second to none.

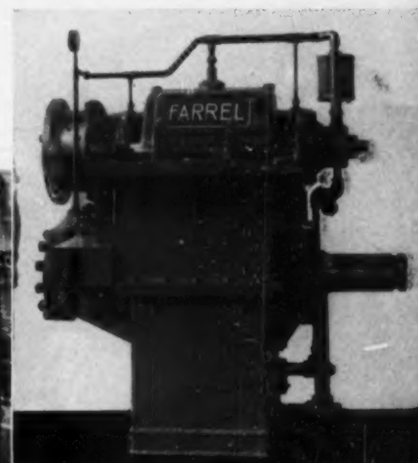
The Farrel-Birmingham Company, Inc., is proud to have contributed to the success of these vessels by supplying reduction gear units for use with the propulsion engines in each boat.

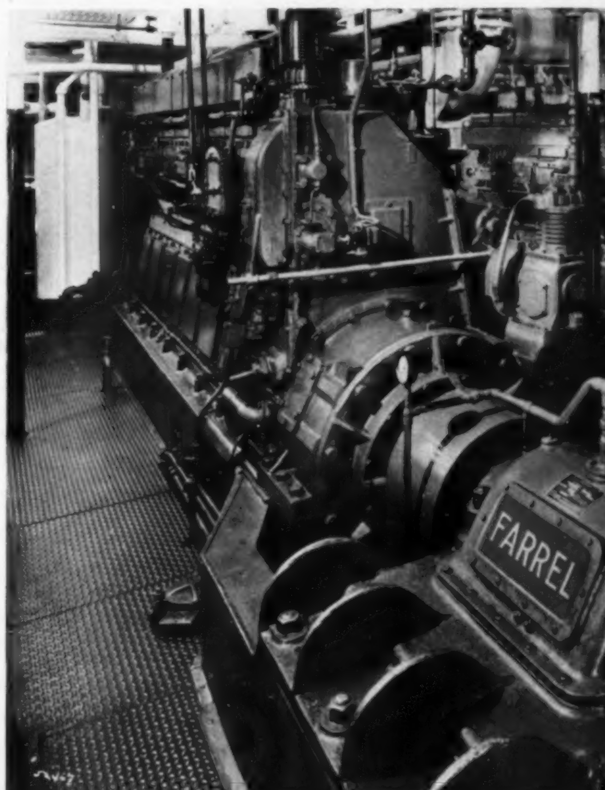
Through the use of Farrel gear units it was possible to employ a much lighter and smaller high speed Diesel engine to provide the same propulsion power without the sacrifice of proper propeller speed for safe and satisfactory maneuvering. The use of Diesel gear drive for marine installation decreases engine room space and propulsion equipment weight, the immediate advantages of which are greater cargo space and carrying capacity and, hence, greater operating profits.

It will pay you to investigate Farrel reduction gear drive when considering the installation of a marine Diesel engine.

Right—**One of the Farrel Gear Units which transmits 600 hp. and reduces the engine speed of 625 rpm. to a propeller speed of 200 rpm.**

Below—**Starboard side of *Green Island's* engine room showing one of the Farrel Gear Units and Cooper-Bessemer Diesels.**

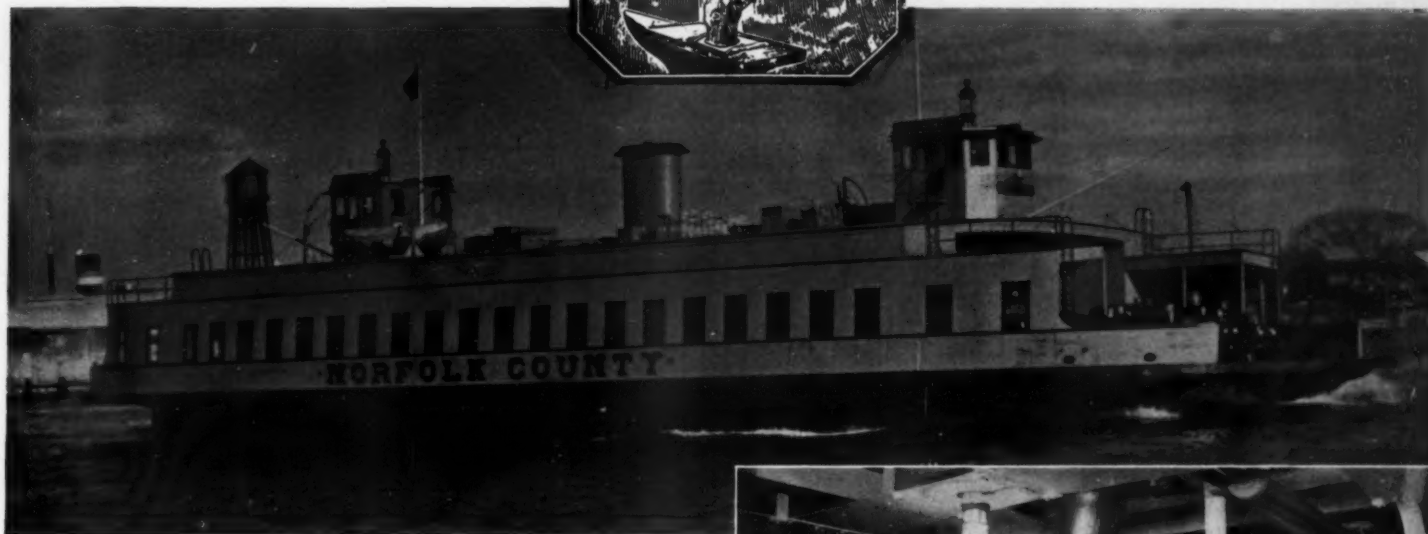


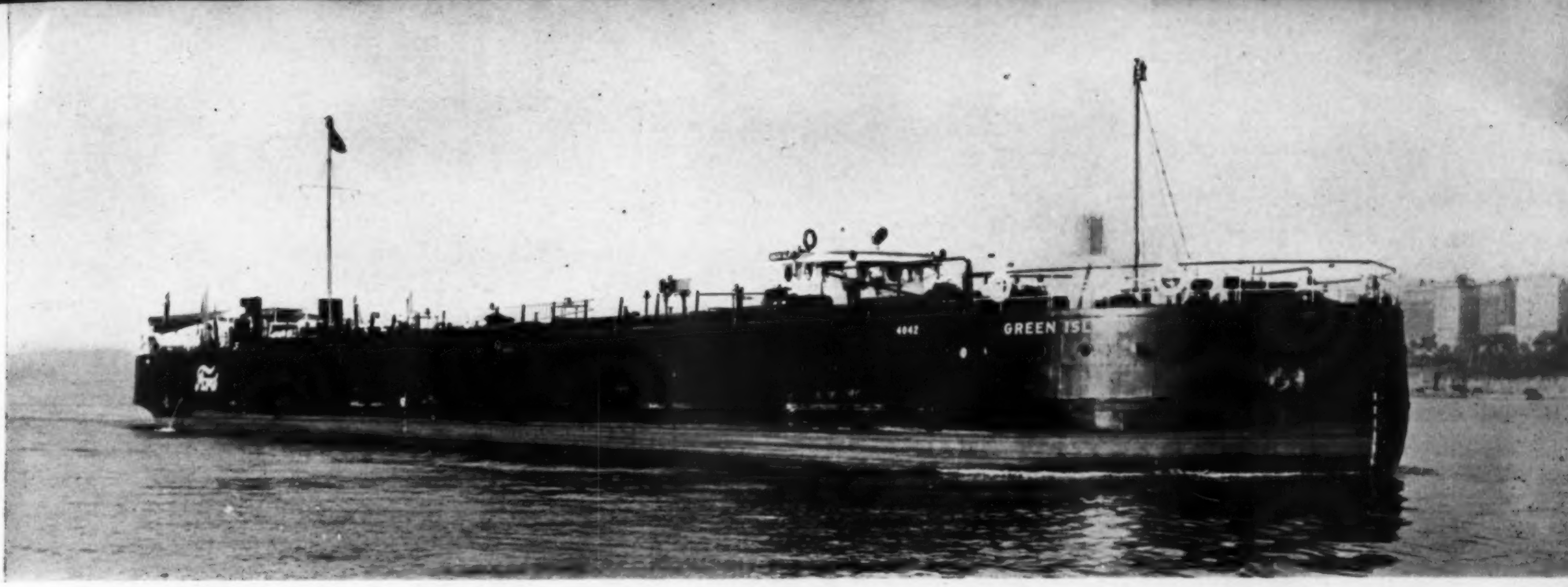


FARREL-BIRMINGHAM COMPANY, INC.

385 Vulcan St., Buffalo, N. Y.

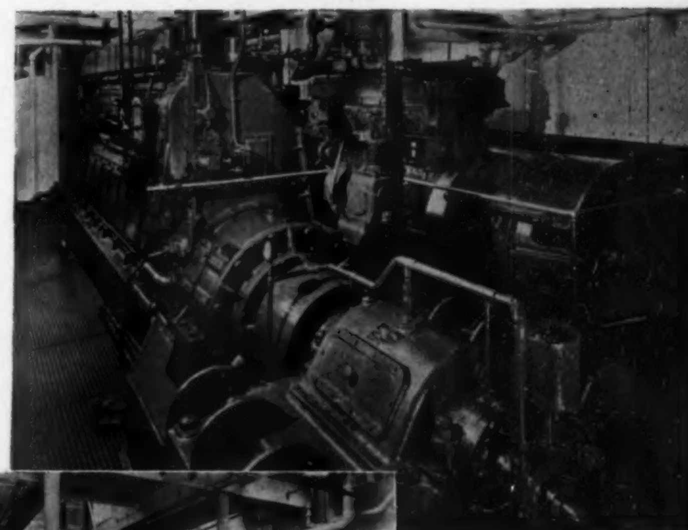
New York: 79 Wall St. Los Angeles: 2026 Santa Fe Ave.


NORFOLK COUNTY



EIGHT COOPER-BESSEMER DIESELS DRIVE THE TWO NEW FORD FREIGHTERS

All Eight Were Built With Ellwood City Forge Crankshafts



THE *Green Island* and *Norfolk*, 300-ft., 1600-hp. Diesel freighters, recently built to the order of the Ford Motor Company of Detroit, Michigan, are the last word in the marine Diesel installations for 1937.

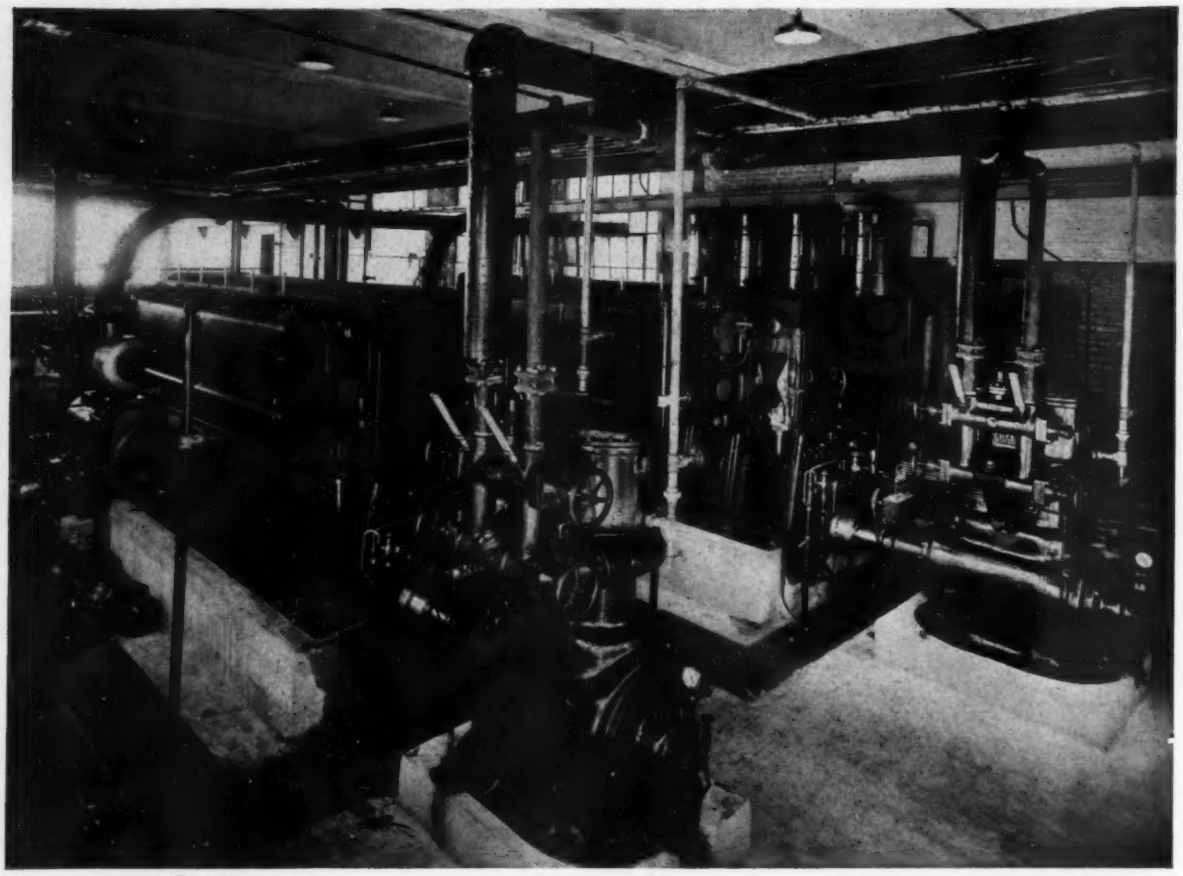
The Ellwood City Forge Company wishes to congratulate the Ford Motor Company, owners, Gielow, Inc., Naval Architects, and the Cooper - Bessemer Corporation who furnished the Diesel engines for these two outstanding vessels, and takes pleasure in announcing that Ellwood City Forge Crankshafts were used throughout in both main propulsion and auxiliary Diesels.

Through the recent purchase of the Crankshaft Department of the Union Drawn Steel Company, Beaver Falls, Pa., the Ellwood City Forge Company is now in a position to furnish Diesel crankshafts for engines in the lower horsepower ranges. These shafts, of course, will have the same accuracy, stamina and workmanship which have characterized the larger sizes in the past, and which have led to their selection for many of the most important Diesel installations in this country.

ELLWOOD CITY FORGE CO.

CRANKSHAFTS . . . CONNECTING RODS . . . MACHINE FORGINGS

ELLWOOD CITY, PENNA.



Ice production at 25 cents per ton means low cost power—power from Superior Diesels

Two Superior Diesels of a combined capacity of 735 horsepower help to make the Bridgeport, Connecticut, plant of the Southern New England Ice Company one of the high efficiency plants of this country.

Any large user of power is almost certain to find some application of a single or multiple combination of Superior Diesels which will save their reasonable cost many times over. Whether you can use the highly efficient direct connected drive, like the ice machines in this plant, or whether you should use electric generating sets to produce power at one-half cent to one cent per K.W.H. is something our sales engineer will be pleased to help you work out.

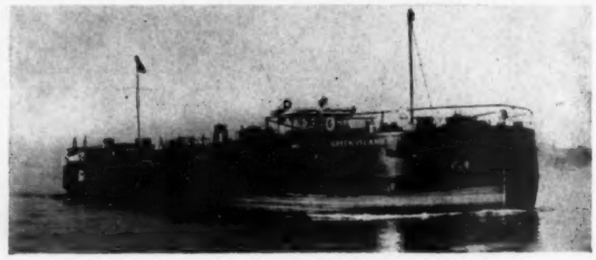
This service is free. Ask about it.

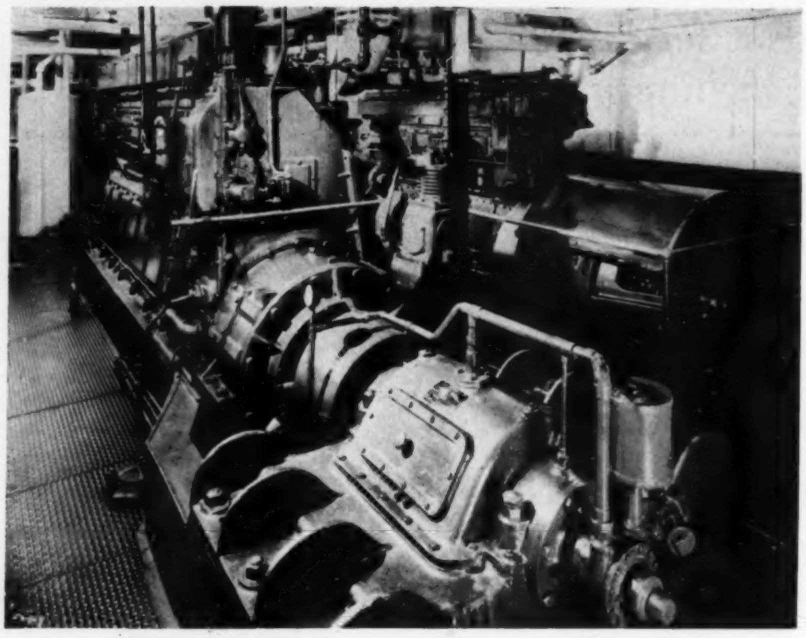
THE NATIONAL SUPPLY COMPANY
OF DELAWARE
SUPERIOR ENGINE DIVISION, SPRINGFIELD, OHIO
LOS ANGELES, CALIFORNIA PHILADELPHIA, PA.

Superior DIESELS

HEAVY DUTY MODELS: 50 to 810 H.P., 250 to 720 R.P.M. • HIGH SPEED MODELS: 15 to 150 H.P., 900 to 1800 R.P.M.

For
FORD MOTOR CO.'S
DIESEL-POWERED
FREIGHTERS
"GREEN ISLAND"
and "NORFOLK"





The
COOPER-
BESSEMER
CORP'N.
Selected

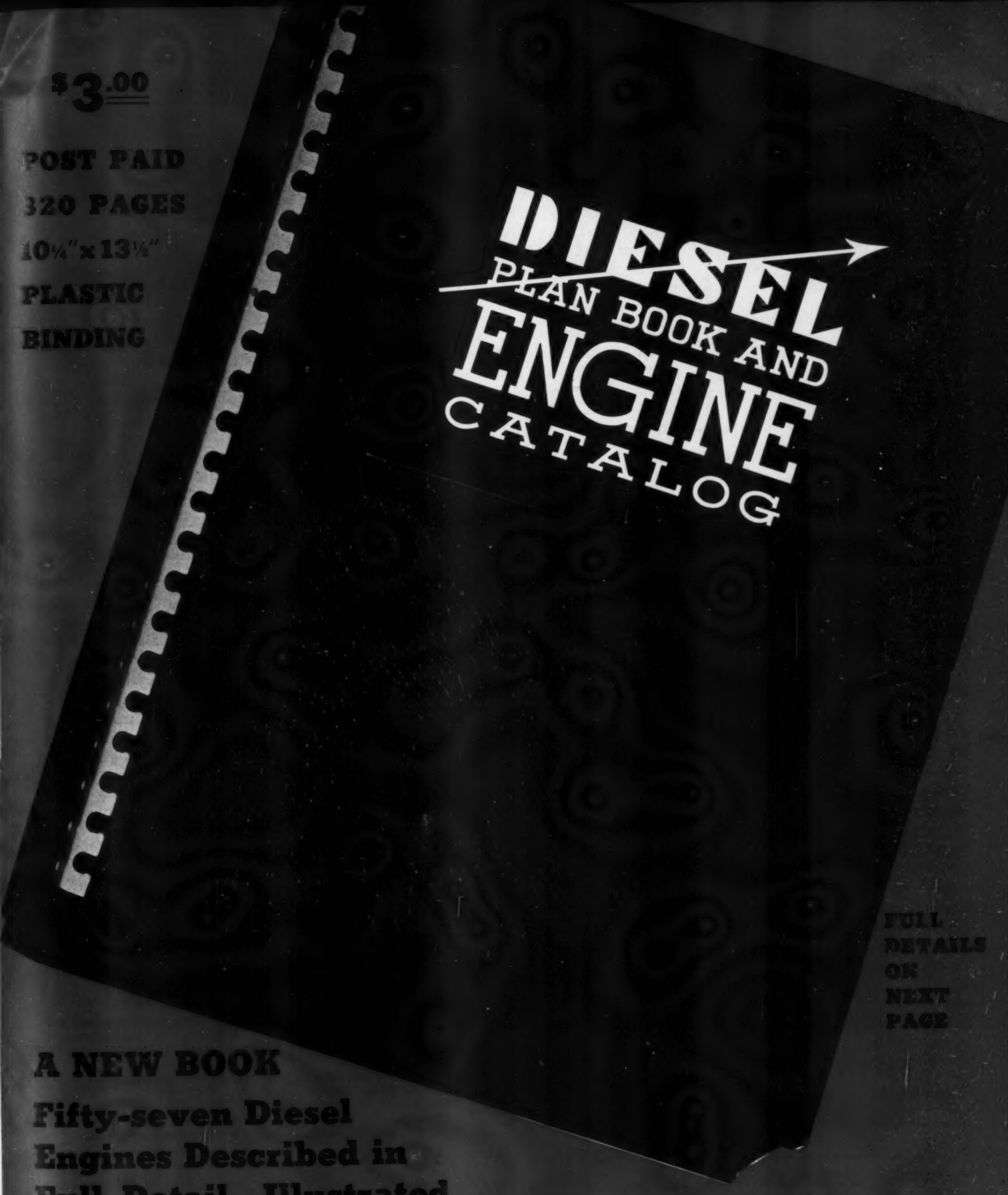
PRECISION BEARINGS

EACH of these new freighters, representing "the last word in Marine Diesel installations," is powered with two 600 HP Cooper-Bessemer Diesels for the main drive, and two 225 HP Cooper-Bessemer Diesels for auxiliary generator drive. **** For these units, Cooper-Bessemer Engineers selected NORMA-HOFFMANN PRECISION BEARINGS for water pump and compressor drive shafts, compressor flywheel shafts, governor linkage and camshaft assemblies, governor weight forks, and tachometer drive shafts. **** For heavy-duty engine service, as for so many other exacting duties throughout Industry, engineers and designers find in NORMA-HOFFMANN PRECISION BEARINGS those rugged qualities which assure long life, high economy, and dependable performance.

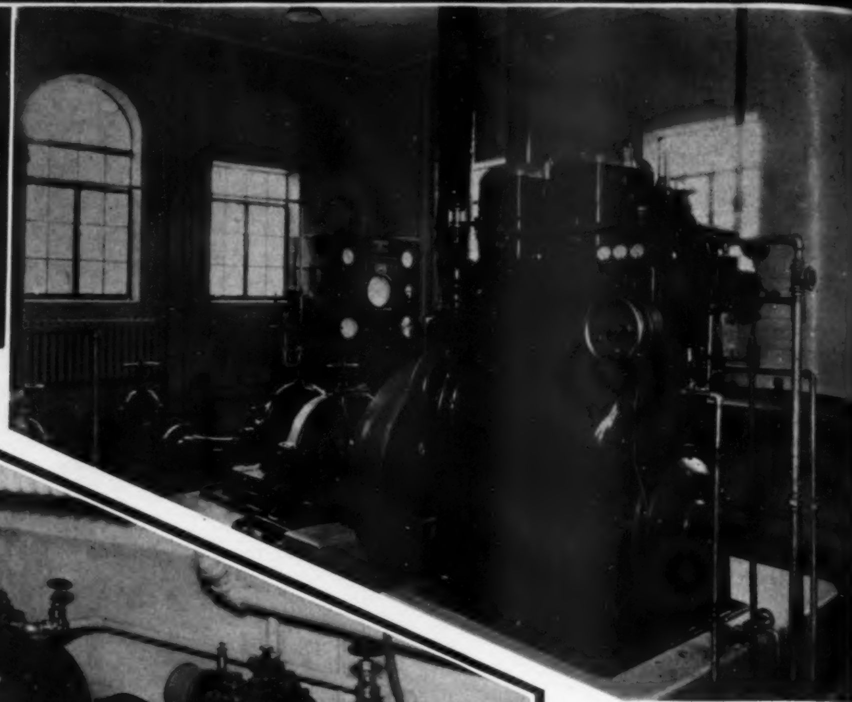
The NORMA-HOFFMANN PRECISION line includes 108 distinct series, embracing over 3000 catalogued sizes—Ball, Roller and Thrust Bearings—a PRECISION Bearing for every load, speed, and duty. Write for the Catalog. Let our engineers work with you.

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.

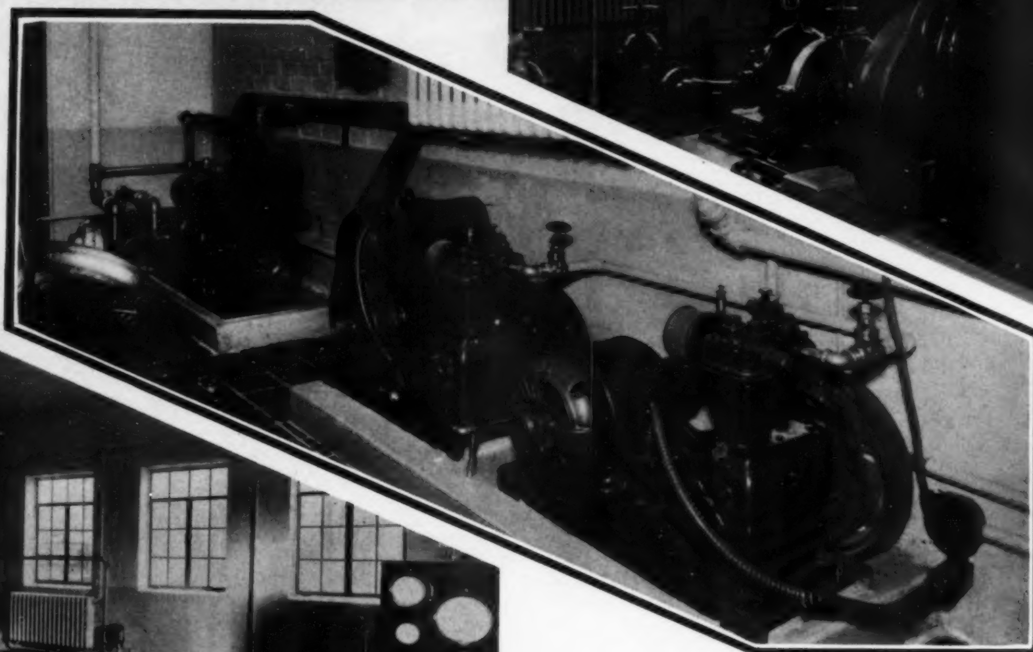
"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST


DIESEL
PLAN BOOK AND
ENGINE
CATALOG

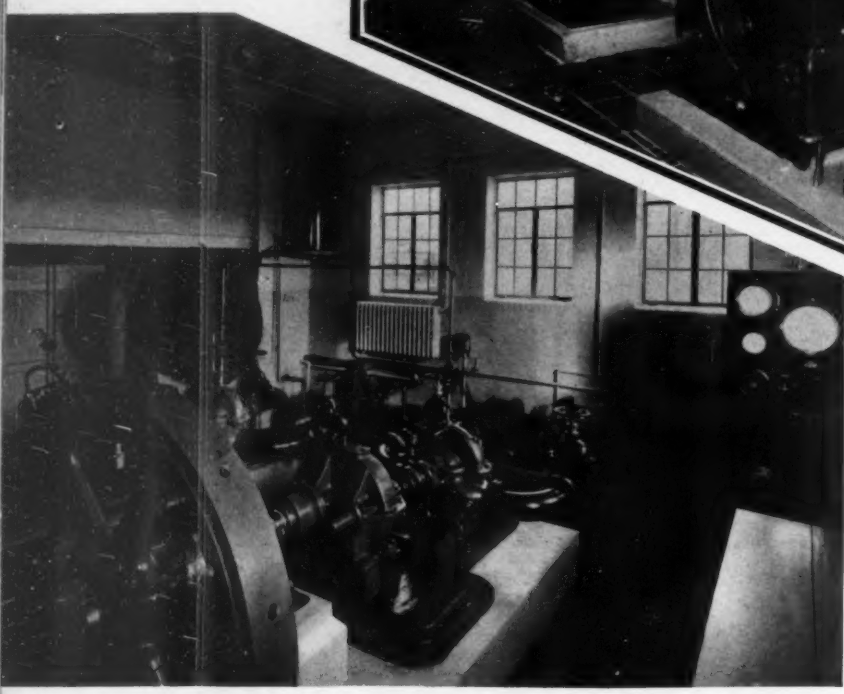
STARTED BY QUINCY



• *AT RIGHT—Sure Fire starting is assured by these Model DC-10 2 hp. Quincy Compressors. Similar dual units provided with motor and gasoline engine drive are employed in both Harwich and Cotuit.*



• *ABOVE — In the efficient Cotuit station a 60 hp., 600 r p m. Worthington Diesel engine drives a Pennsylvania pump. The Quincy starting units are not visible but they are there ALWAYS ON THE JOB.*



• *ABOVE—A trim, smooth functioning installation is this Harwich job with its Fairbanks-Morse 60 hp., 360 rpm. Diesel, driving, through Falk speed increasing gears, a Pennsylvania single stage 4" centrifugal pump. The Quincy starting compressors are in the background.*

MORE AND MORE ENGINEERS

are advising

"Install a QUINCY"

MORE industrial and municipal power plants and water works are swinging over to the economy of Diesel power. The use of Diesels in marine circles is constantly increasing. Paralleling these developments, the prestige of engineer-preferred Quincy compressors has attained notable proportions.

Quincy two-stage starting units from ¾ hp. to 7½ hp. in size, and for pressures up to 500 lbs. per square inch are available with both electric motor and gas engine drive. For further information, write direct to the factory, Quincy, Illinois.

"No Service Interruptions"

is the Slogan at

Harwich and Cotuit Water Works

ANOTHER expression of engineer preference for Quincy Starting compressors is evidenced in the two modern Diesel driven pumping stations in the communities of Harwich and Cotuit, Massachusetts. In each are two Quincy compressors, one motor and the other gasoline driven—thus, unfailing Diesel starting is assured.

The Harwich station is powered by a Fairbanks-Morse, 60 hp., 360 rpm. Diesel engine. The Cotuit plant is equipped with a 60 hp., 600 rpm. Worthington Diesel. Both plants represent the last word in modern Water Works efficiency.

The Boston firm of Whitman & Howard were the consulting engineers; F. A. Mazzur Company, Inc., also of Boston, were the installing contractors.

QUINCY COMPRESSOR CO.

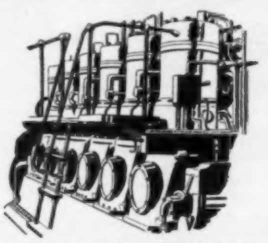
QUINCY, ILLINOIS

Branch Offices at New York and Chicago

WHERE AIR IS IMPORTANT

QUINCY Compressors

RIGHT DOWN YOUR ALLEY



One User Sells the Next on Nonpareil Diesel Oil

Diesel engine operators who have tried and use Nonpareil Diesel Oil are its best salesmen. Read the following letter from one municipal power plant superintendent to another:

". . . As we have used the Nonpareil Diesel Oil (Heavy) since installing our first Diesel unit some three years ago, the Standard Oil Engineer suggested that I write you stating our experience on the performance of this oil.

It is a pleasure to state that the oil is giving us the very best of service, and as a further proof of our entire satisfaction will state that the same grade of lubricating oil will be used in our new 1000 K.W. 1400 H.P. Fairbanks Morse Diesel unit now being installed . . ."

The letter concludes with an expression of appreciation for the valuable service the Standard Lubrication Engineer renders in making a periodical laboratory analysis of the Diesel Oil in use.

If you need further proof of the cost-saving, high quality of Nonpareil Diesel Oil, let a Standard Lubrication Engineer test it in your own plant, on your equipment.

NONPAREIL DIESEL OIL
STANOLIND M
STANOIL—SEVEN GRADES

For your information on

"DIESEL ENGINE BEARING LUBRICATION"

It discusses lubrication on large stationary Diesel units where separate systems are provided for cylinders and bearings. The cause and cure of oil foaming, sludge and excessive consumption are suggested with general and specific recommendations for bearing lubricants. This and the other monographs listed below provide a valuable library of facts on Diesel operation. They are free—just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

"Diesel Cylinder Lubrication"
"Diesel Engine Air & Fuel Cleaning"
"Lubrication of Diesel Air Compressors"
"Service Test of Diesel Oils"

"DON'T THANK ME, MR. MORTON,

Your Superintendent, there, made these savings possible."

HE isn't just tossing bouquets, either. In making that statement the Lubrication Engineer is perfectly sincere. You'll find that typical of all Standard Engineers—typical of their attitude and the methods they use in working with anyone in your plant.

It's plain common sense. The superintendent, in this case, was the man who called in the Engineer. His foresight was directly responsible for whatever saving resulted from their study of the lubrication problem.

Although thoroughly familiar with lubricants and their application, Standard Engineers know that conditions vary from plant to plant, even on machines of the same type and make. The men on machines, the foremen in charge, the plant engineers—all have an intimate knowledge of the equipment they operate. A Standard Lubrication Engineer values and respects their opinions.

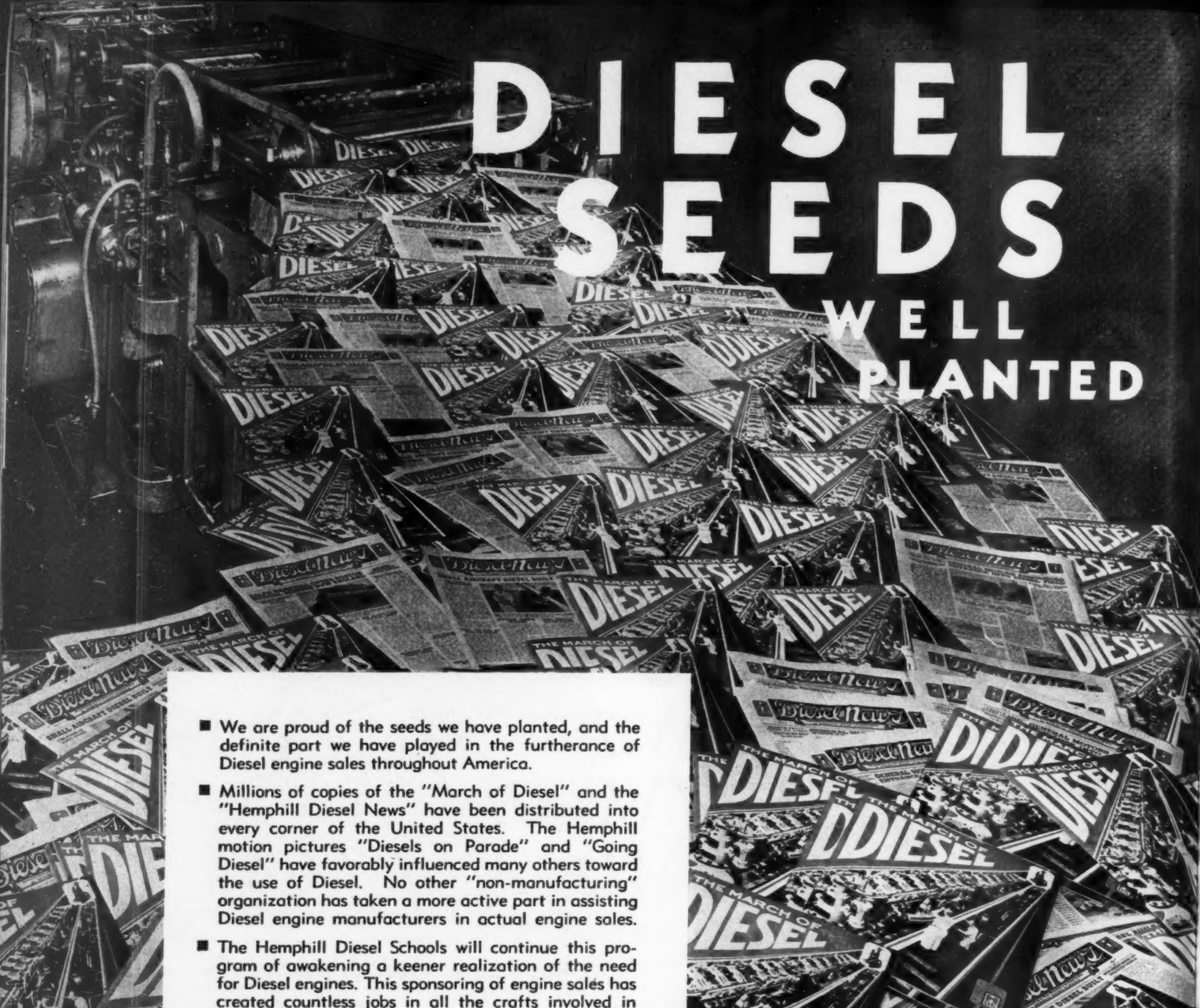
When you call a Standard Engineer he works *with* your organization, contributing his knowledge in a spirit of helpful cooperation. His only reward for the savings you make is the good will it brings his company and Standard Oil products.

This helpful, friendly service is yours for the asking. Just call your local Standard Oil (Indiana) office and ask for a Lubrication Engineer.

THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS

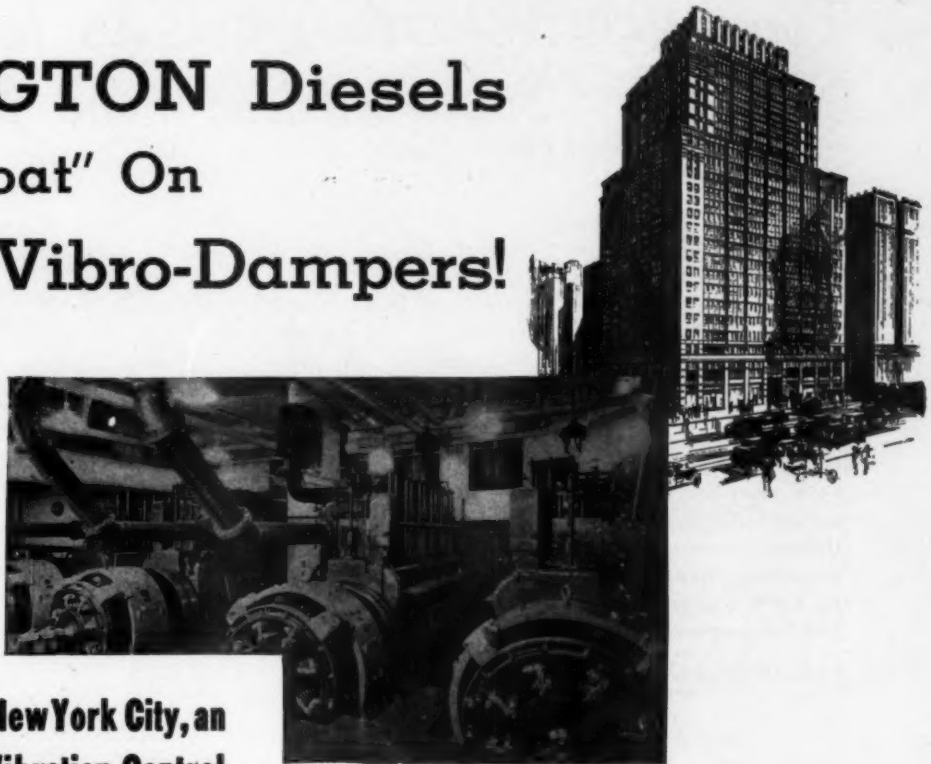
STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING


DIESEL
SEEDS
WELL
PLANTED
■ We are proud of the seeds we have planted, and the definite part we have played in the furtherance of Diesel engine sales throughout America.
■ Millions of copies of the "March of Diesel" and the "Hemphill Diesel News" have been distributed into every corner of the United States. The Hemphill motion pictures "Diesels on Parade" and "Going Diesel" have favorably influenced many others toward the use of Diesel. No other "non-manufacturing" organization has taken a more active part in assisting Diesel engine manufacturers in actual engine sales.
■ The Hemphill Diesel Schools will continue this program of awakening a keener realization of the need for Diesel engines. This sponsoring of engine sales has created countless jobs in all the crafts involved in Diesel engine building.
■ The Hemphill Schools will continue to train men to KNOW DIESELS for this industry — men who will be able to measure up to the exacting requirements necessary for its further advancement — trained men who may become the "problem solvers".— men who have mastered the scientific data and information gathered exclusively by the Hemphill Schools from all parts of the industrial world concerning the many types and makes of Diesel engines — fuel and lubricating oil requirements — the various injection systems — testing apparatus — maintenance problems repairs, service and sales.
HEMPHILL DIESEL SCHOOLS
are located in these strategic industrial and marine centers—
BOSTON, 110 Brookline Avenue
NEW YORK, 31-28 Queens Blvd., L.I.C.
DETROIT, 2340 W. Lafayette Blvd.
CHICAGO, 2020 Larrabee Street
MEMPHIS, 421 Monroe Avenue
LOS ANGELES, 2121 San Fernando Rd.
SEATTLE, 503 Westlake North
VANCOUVER, B.C., 1365 Granville St.
H D.S.

KORFUND PROTECTS ADVANCES IN DIESEL ENGINEERING

WORTHINGTON Diesels "Float" On KORFUND Vibro-Dampers!



Installation in 2 Park Ave. Bldg., New York City, an Interesting Example of KORFUND Vibration Control

THE decision of the management of the 28 story office building at 2 Park Avenue, New York City, to install their own power plant, consisting of four 450 hp. WORTHINGTON DIESELS driving 300 KW generators, raised the question of how any vibration that might occur should be handled so that the tenants of the building would not be annoyed by the transmission of the normal vibrations of operating machinery.

The foundation isolation problem was solved interestingly. Bed rock was about 15 ft. below the boiler room floor. Concrete piers were put down to bed rock and a heavy reinforced concrete mat set on top of the piers and made a part of them. Above this mat and supported by it are the concrete engine foundation blocks about three and one-half feet thick, carried on KORFUND Vibro-Dampers. This "floating foundation" arrangement has been most satisfactory. With the powerful WORTHINGTON Diesels in operation, there is no tremor or vibration whatsoever in the building.

Leading Diesel manufacturers and designers and owners of Diesel power plants have turned to KORFUND for the satisfactory solution of the problems arising from vibrations. The advances in Diesel engineering and the economies made possible through Diesel operation are thus being protected by KORFUND—and the satisfaction of Diesel owners is assured where KORFUND Anti-Vibration Products are applied.

KORFUND Engineers, backed by thirty years' experience and the latest scientific knowledge—plus the assurance gained from over 200,000 successful installations—will be glad to advise you regarding methods, products and estimated costs. Write NOW for our new, attractive illustrated booklet, "Eliminating Vibration Losses."

THE KORFUND COMPANY, Inc.
48-26 32nd PLACE • LONG ISLAND CITY, N. Y.

THE KORFUND CO., INC.,
48-26 32nd Place, L. I. City, N. Y.

Please send me your booklet, "Eliminating Vibration Losses."

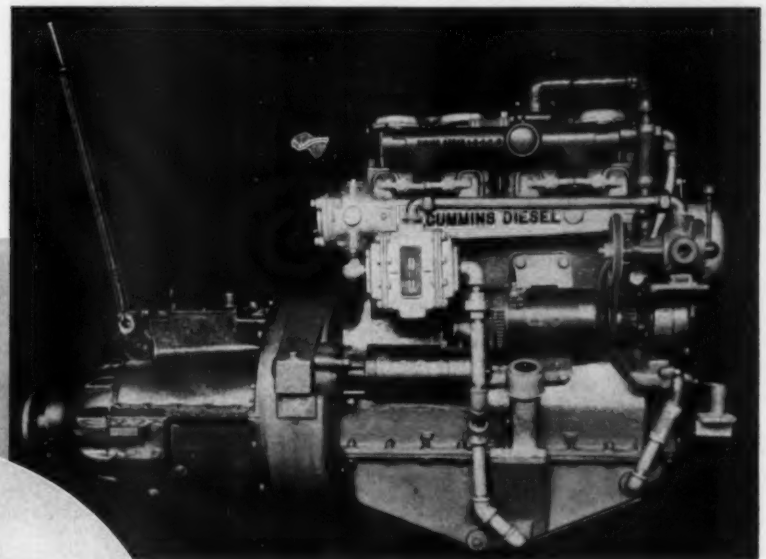
Name..

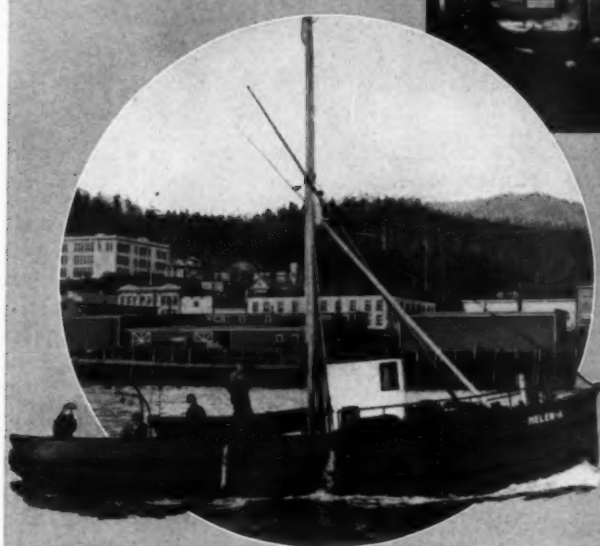
Firm..

Address...

City.......................... ....State..........

The Helen A is powered with a 4-cyl. Cummins Diesel Engine, developing 55 hp at 1200 rpm, equipped with a Model MG-60 Twin Disc Marine Reverse and Reduction Gear Unit.





A *Continuous* REVERSE SPEED THAT IS 100% of FORWARD SPEED

The fishing tug *Helen A* of Ketchikan, Alaska, owned by Richard Apsch, handles with unusual speed and accuracy. It may be operated full speed astern *continuously* as long as desired because the Twin Disc Marine Reverse and Reduction Gear with which its engine is equipped permits *a reverse speed that is 100 per cent that of the forward speed.* The Twin Disc Reverse Gear needs no adjustment. Its lubrication is not connected with the engine. The self-contained oil pump circulates *clean oil* continuously.

Twin Disc Reverse and Reduction Gear Model MG-60 used in this tug is manually operated and designed for engines rated 60 hp at 1200 rpm, 2:1 or 2¼:1 ratios. Model MG-160, power operated by a hydraulic cylinder, is suited to Diesels rated 160 hp at 1200 rpm, 2:1 or 3:1 ratios. *Write for Bulletins 104 (MG-60) or 103 (MG-160).* Twin Disc Clutch Company, 1345 Racine St., Racine, Wisconsin.

TWIN DISC CLUTCH COMPANY
RACINE, WISCONSIN

TWIN DISC CLUTCHES

MARINE REVERSE AND REDUCTION GEARS

NO. 6 OF A SERIES

Physician's Insight; Surgeon's Technique

Dieselized!

Just as the Physician is trained to understand the functions of the human body, and the Surgeon develops operating skill, through research and experimental demonstration—so students of the National Schools are thoroughly trained in both the practical mechanics and in the underlying theories of Internal Combustion Engines. They understand the fundamental principles on which an engine operates just as the Physician and the Surgeon know the body. With a basic knowledge of the laws of construction, they go into mechanical processes as the Doctor goes into human anatomy.

Actual modern engines—Diesel, Special Fuel, Gasoline, etc., are available for study and experimentation. National students take Diesel engines apart—put them together again—dissect and reconstruct. They learn how to diagnose troubles, locate defects, prescribe remedies, make repairs. They get a Physician's insight with a Surgeon's technique. If an engine is in good health, they know how to keep it healthy. If it gets sick, they know what to do to cure it, promptly and effectively.

National students are thoroughly trained in both theory and practice. In addition, they are men who have the vision to invest time and money in training in order to make themselves more valuable to industry. A business is no stronger than its personnel. Many leaders in the Diesel Industry have found National graduates to be the type of men they seek as the backbone of their organizations.

Founded in the very early days of the Internal Combustion Engine—long before Diesel power was commercially developed—the National Schools have grown side by side with the industry. National training has always been kept strictly in line with modern developments.

National graduates do not have to complete their practical experience at the expense of their employers, because they receive intensive, every day experience in National's own shops and laboratories, representing a million dollar investment. Owners of Diesel-powered equipment are constantly seeking graduates of National Schools, because these graduates are trained with a precision which combines the thoroughness of the Physician with the skill of the Surgeon.

NATIONAL SCHOOLS were established in Los Angeles in 1905—have continued without interruption under the management of the founders, with a definite policy of honesty, sincerity and worthiness of purpose. Today, National Schools offer sound, thorough, practical instruction courses in DIESEL AND OTHER INTERNAL COMBUSTION ENGINES, RADIO AND TELEVISION, ELECTRICITY.

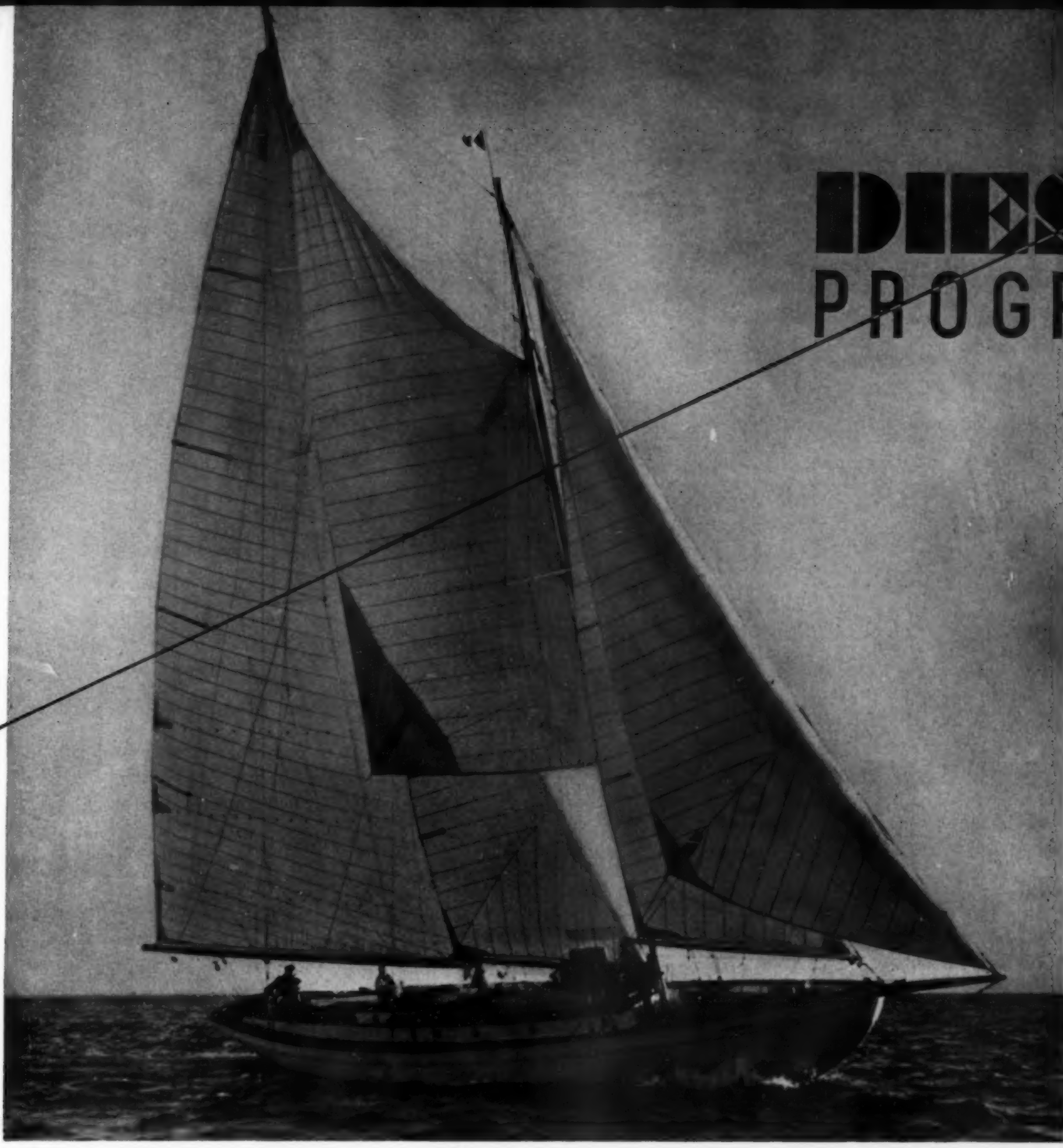
•

Information concerning these courses, or Employer Service regarding graduates, will be gladly given on request. You can profitably employ men of National calibre.

NATIONAL SCHOOLS

4000 South Figueroa Street • Los Angeles, California

[PIONEERS OF PRACTICAL TRAINING FOR 32 YEARS]



DIESEL PROGRESS

CONTENTS • AUGUST

FRONT COVER ILLUSTRATION – The *Green Island,* 1,600 hp. Cooper-Bessemer Diesel Freighter recently delivered to the Ford Motor Company for service between Detroit, Edgewater, N. J., and Chester, Pennsylvania. Gielow, Inc., were the Naval Architects.

TABLE OF CONTENTS ILLUSTRATION – The 50-foot staysail rigged schooner *Jorie,* owned by Harold Judson of Los Angeles and powered with a four-cylinder Buda Diesel driving through a 2 : 1 reduction gear to give a speed of seven and a half knots.

DIESEL PROGRESS for August, 1937, Vol. III, No. 8. Published monthly by Diesel Engines, Inc., 2 West 45th St., New York, N. Y. Tel. MUrray Hill 2-5092.

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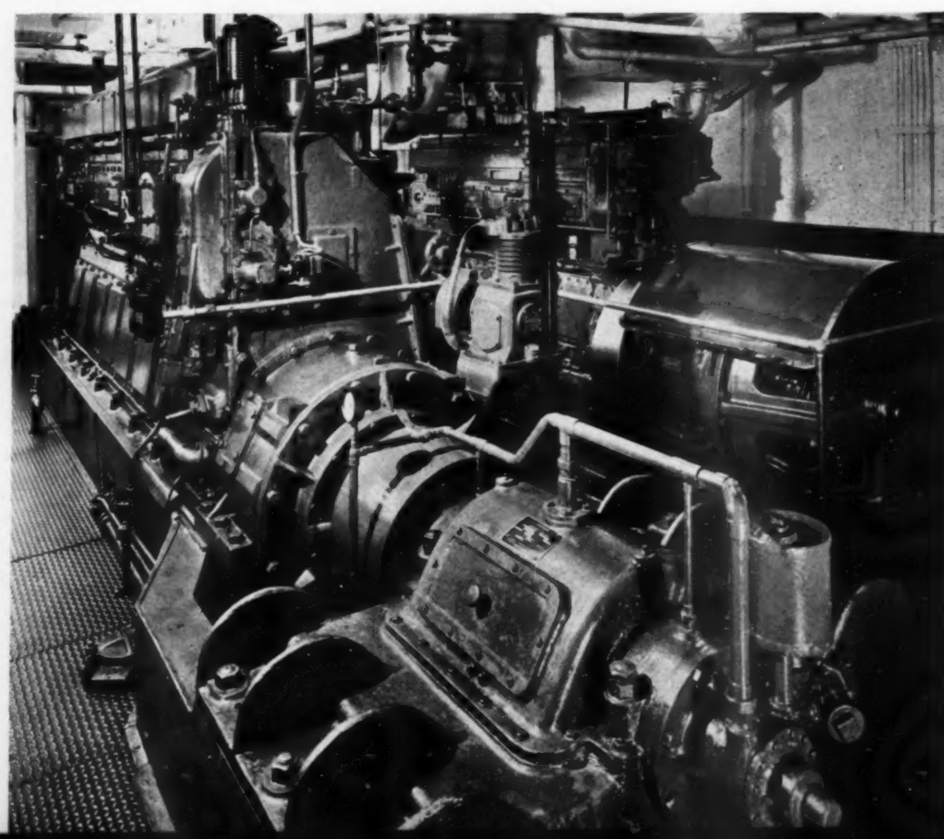
DIESEL GEARED FREIGHTERS "GREEN ISLAND" AND "NORFOLK"

The Ford Motor Company Places Two New Cargo Vessels in Service

SINCE 1934, The Ford Motor Company has been operating two steamers between their manufacturing plant in Detroit and assembly plants at Edgewater, N. J. and Chester, Pa. It is significant that, when the time came to add another pair of vessels to this service, Ford engineers selected Diesel engines for both main propulsion and auxiliary power. All four boats were designed by Gielow, Inc., Naval Architects, and are almost identical in appearance as well as general dimensions. The latter two, the *Norfolk* and *Green Island,* are decided improvements over any other ship in the New York State Barge Canal service and boast the greatest cubic and tonnage capacities within canal limitations.

The new boats, similar to the first pair, the *Chester* and *Edgewater,* have an overall length of 300 feet, a beam of 43 feet, draft of 9 feet, 6 inches and a displacement of 2,922 tons. A propeller speed of 200 rpm. is another point of similarity with the steam craft. This is accomplished by means of Farrel-Birmingham reduction gears placed between each Diesel and its corresponding propeller. A Farrel gearflex coupling takes up any possible misalignment between the engines and gears. Each vessel is twin screw, carrying two type GN, eight-cylinder, Cooper-Bessemer Diesels rated at 600 hp. at 625 rpm. Port and starboard auxiliaries are also Cooper-Bessemer, type EN, six-cylinder units which drive 230-volt 150 kw. Crocker-Wheeler D.C. generators at 700 rpm. Kingsbury thrust bearings are built into both Farrel gearboxes and continuous, forced spray lubrication is provided for the gear teeth. Strict performance specifications regarding vi-



The "Green Island," first of the two 1,600 hp. Cooper-Bessemer Diesel freighters, on her maiden voyage. She is shown here as she was leaving the Ford plant at Edgewater, N. J., on her way to Chester, Pa., to discharge the balance of her cargo from River Rouge.

Below — is a general deck view during the stop at Edgewater. Material consigned to the plant is being taken off the port side, while a lighter at the right is transferring export shipments. The main engines with Farrel-Birmingham reduction gears and the auxiliary engines with Crocker-Wheeler generators appear at the bottom of the page.

bration and noise also require that main engines and gears reverse from full speed ahead to full speed astern in not over ten seconds under normal operating conditions. Propellers are of bronze and measure 7 feet, 6 inches in diameter by 6 feet pitch. Considering the size of these wheels and the efficient speed at which they turn, the tremendous advantage of gear drive is obvious. It is estimated that at least twelve feet of engineroom length is saved in this manner as compared with steam or direct Diesel drive. With the machinery space in the stern, shafting is reduced to the minimum and cargo holds are uninterrupted fore and aft. Fuel oil tanks are abreast of the engineroom bulkhead leaving the double bottom tanks available for fresh water only. Cargo holds are completely clear of brackets, piping and other obstructions usually found in vessels of this type.

All auxiliary equipment on the new vessels is electrically operated which accounts for the two Diesel generating sets of 300 kw. combined capacity. With the pilot house designed to recede into the weather deck to clear the canal, this is an ideal arrangement since the only connections necessary between it and the ship proper are flexible power cables. Principal auxiliaries are the two motor-driven Gardner-Denver air compressors; a single 28 point Alnor

View of the "Green Island's" engine room looking athwartship from the port generator side.

pyrometer serving all four Diesels through 28 thermocouples; Sharples, en bloc, lubricating oil centrifuge; Vortex spark arresting exhaust silencers; and, of course, the customary pumps, winches, capstans, etc., found on shipboard regardless of the type of power installed. The Cooper-Bessemer Diesels carry the more essential engine auxiliaries built-in and directly connected, such as Purolator fuel oil filters, Curtiss compressors, and fuel pumps. Both main and auxiliary Diesels operated with Andale closed, fresh water cooling systems.

Perhaps one of the most interesting points regarding these four vessels is the remarkable savings effected in the latter two which, in addition to being Diesel powered, are also welded, whereas the first two steamships are riveted. The enormous saving in engineroom space due to Diesel gear drive has already been mentioned. Taking a few specific comparisons of the two pairs of vessels built from practically identical hull plans and having exactly the same displacement, reveals other major economies in the *Norfolk* and *Green Island.* Naturally, in defense of steam, it will be stated that the older vessels are rated at 1,600 hp. against the Diesel 1,200 hp. for main propulsion. Actually, available power is practically the same.

Saving in hull construction due to welding may be summarized as follows: 10 per cent in time, 10 per cent in materials (laps, butts, etc.), 15 per cent in cost. Comparing relative weights of fuel, lubricating oil and water for the two types of power shows a net saving for the Diesels of 156 tons or 38 per cent. Actual machinery weights favor the Diesels by 63 per cent. These figures are most impressive in themselves but when one considers that the Diesel vessels have 341 tons *more cargo capacity* in addition, it sounds almost like a case for Mr. Ripley and indicates clearly the ever increasing acceptance of this modern type power. Certainly the *Norfolk* and *Green Island* are keyed to the spirit and tempo of efficiency which characterize every activity of the Ford Motor Company.

NOTES ON TRIALS AND MAIDEN VOYAGE OF MOTORSHIP *GREEN ISLAND*

By W. M. RICE
Gielow, Inc., N. A.

THE Motorship *Green Island* had a trial trip on June 28, extending for eight hours through traffic at Detroit and on Lake Erie, testing speed and maneuverability. Tests were then made on the windlass, pilot house raising gear, mast raising gears, capstans, automatic tension winches, and duplicate steering gears. In the engine room, tests of the two main engines and gears, generators, compressors, ice machine, thermofans, sanitary pumps, bilge and ballast pumps, were made under service conditions.

These tests having proved satisfactory, the *Green Island* landed the visitors and shipyard workers and proceeded to the Ford Motor Co. to start loading for her first commercial trip the day of the trial.

Cargo was taken on for the various assembly plants of the Ford Motor Co. at Green Island, N. Y., Edgewater, N. J., and Chester, Pa.

An inspection of the *Green Island* at the Edgewater plant proved that everything had worked satisfactorily in service.

Particularly pleasing was the increased capacity of 341 tons of cargo carried on the *Green Island* above that carried by the *Chester*, a steam-driven motorship of the same dimensions and displacement, on the same draft.

The *Green Island* carries fuel enough for two round trips, while the *Chester* has enough for one round trip only.

The *Green Island* handled very satisfactorily in the canal and made the transit from Oswego to Waterford, answering 600 bells, in the same time as the steamers, showing that in approaching locks and maneuvering in the canal she was handled equally easily.

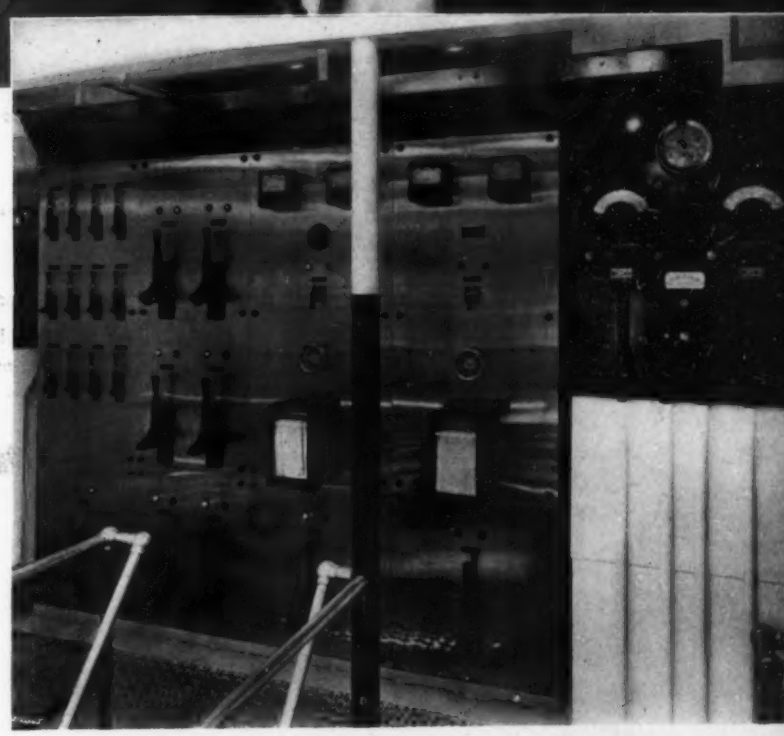
The designed propeller speed is 200 rpm. but the engines can be maneuvered to give a propeller speed of 50 rpm.

The main engines, designed to run at 625 rpm., were run at 525 rpm. on this trip and made a speed, fully loaded, of 11.25 mph.

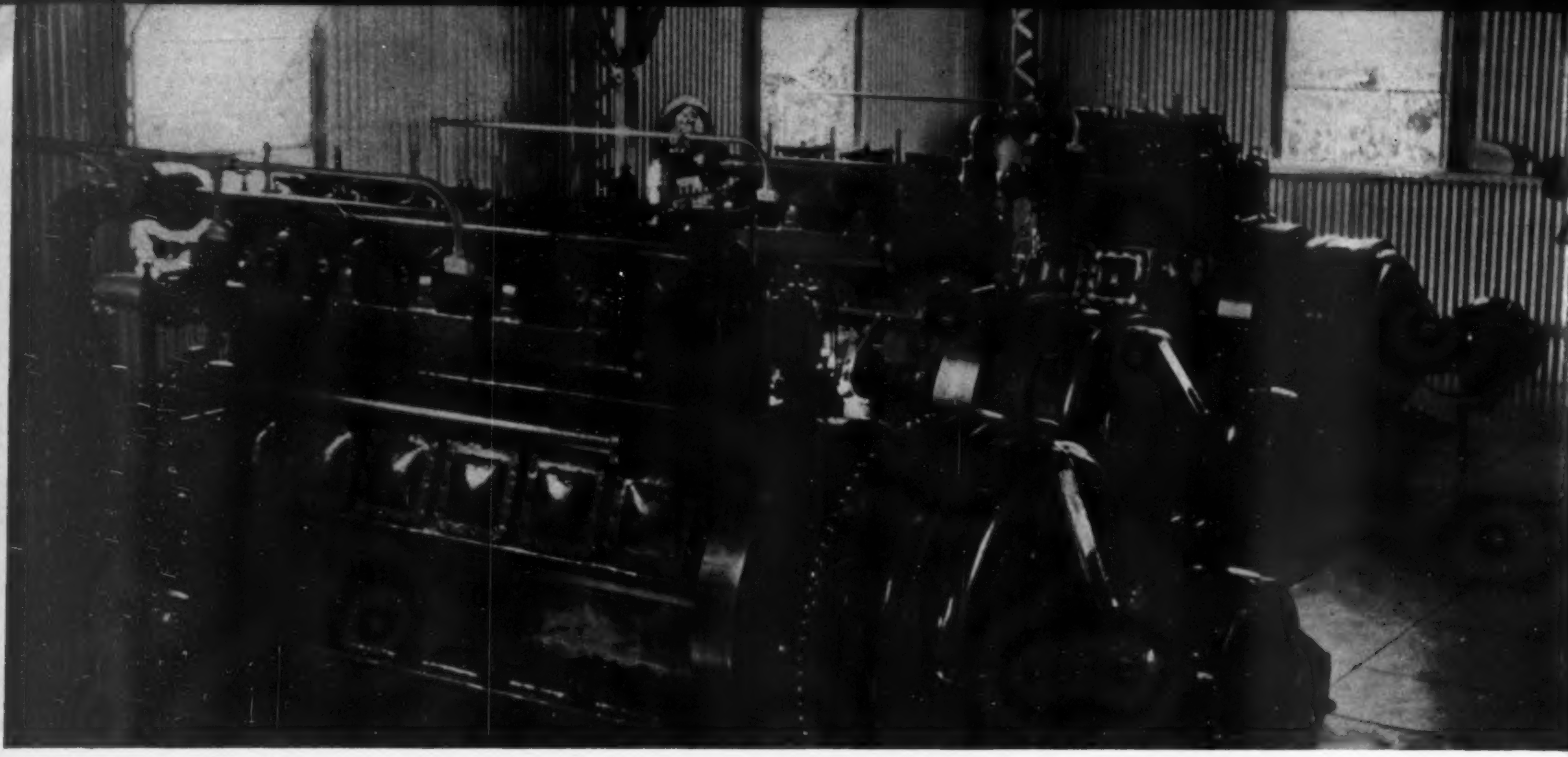
The Cooper-Bessemer Diesels were controlled easily and operated to everyone's entire satisfaction. The Farrell-Birmingham gears were opened up and inspected and found to be in perfect condition.

The Crocker-Wheeler generators were in continuous operation for the entire trip and proved to regulate very closely even with the full capacity demand from the automatic winches while in the Welland Canal locks.

The thermofan cooling system forward and aft was given a hard test and found satisfactory.



Two views of the upper engine room control station. In the top (center foreground) appears the specially designed Cooper-Bessemer remote engine control. Situated between the Bendix engine room telegraphs this unit gives the operating engineer complete fingertip control of his propulsion Diesels at all times. Andale coolers and Modine radiators appear in the background. The Alnor pyrometer for determining exhaust temperatures in the Diesel cylinders is mounted to the right of the switchboard.



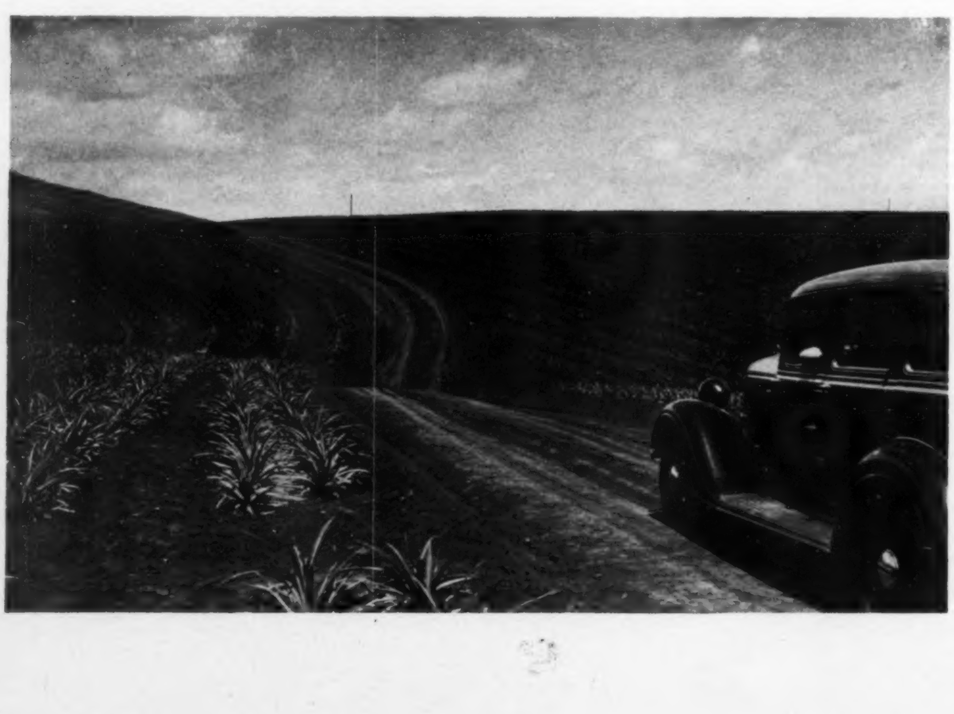
300 Worthington Diesel horsepower serving the "Kona coffee section" of Hawaii. The latest 150 hp. unit appears in the foreground.

KEALAKEKUA, HAWAII

By JOSEF REUTERSHAN

ON the southwest coast of the island of Hawaii, which is the largest of the group, there is a beautiful little community known as Kealakekua, adjacent to the quaint harbor of Kailua, and nestling between the lower slopes of two volcanic mountains, Maunaloa and Hualalai. One not familiar with volcanic conditions cannot fully appreciate the problems encountered when building a power house, transmission line and distribution system in such a location.

In 1931 the community decided to organize a public utility and developed their own electrical power for distribution throughout this section. In analyzing the domestic and industrial requirements, it was decided to select the most productive section in order to exploit this development. As a result of this decision, the power house was located at Kealakekua, elevation, 1,000 feet, rather than at the harbor of Kailua. Transmission lines were run north and south from this location to cover the most fertile fields in the section.



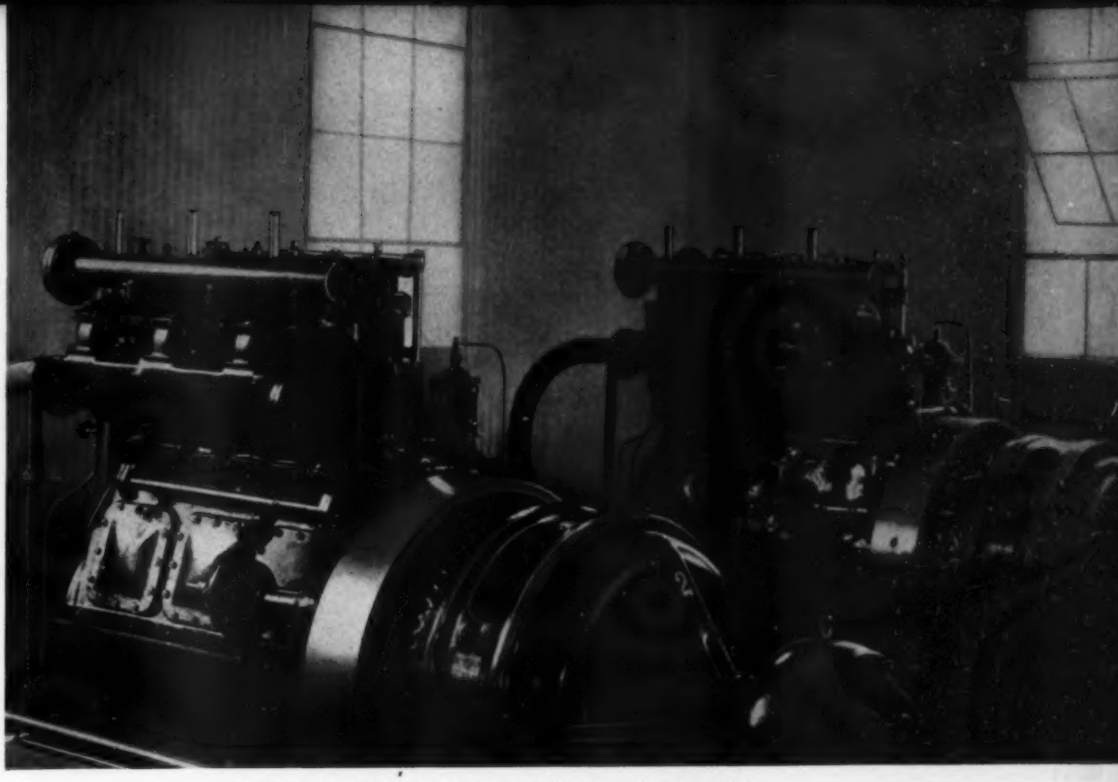
W. A. Ramsey, Limited, territorial agents for the Worthington Pump & Machinery Corporation and the General Electric Company, took a contract to build the power house and the distribution system. On analyzing the requirements for utility service, utilizing Diesel power as a prime mover, it was decided to use a large and small machine so that one, at least, could be kept fully loaded as much as possible. The first installation consisted of two 75 hp. Worthington engines direct connected to General Electric 2,300 volt, 3 phase, 60 cycle alternating current generators. The electrical power is transformed to 6,600 volts for distribution throughout the area. In the transmission lay-

Views at the left and right present typical scenes near the power plant. In country like this Diesel dependability is paramount. Photos by courtesy of the Pan Pacific Press Bureau.

out for the plant, 6,600 volts was selected, as it would give flexibility in that it can be reconnected for 11,000 volts at some future time when the load demand necessitates such a change-over. In 1932 the third unit was added to this power house and was a 150 hp. Worthington Diesel engine, direct connected to a General Electric 100 kw. 2,300 volt, 3 phase, 60 cycle alternating current generator. The power company has been operating under these conditions up to the present time and has proved to be a financial success. The company maintains 24-hour service and has achieved very successful operation from all of the equipment installed.

In 1937 the transmission line was extended 14 miles to the seaport village of Kailua, which is, incidentally, headquarters for the famous swordfishing grounds off the Kona Coast of Hawaii. The development of the two villages of Kailua and Kealakekua in the past few years has augmented the power demand and it is now contemplated to install a fourth Diesel unit in order to adequately meet the requirement.

The prime movers were furnished by the Worthington Pump & Machinery Corporation of Harrison, New Jersey, there being two 3-cylinder and one 6-cylinder Diesel engines of the vertical, 4 cycle direct injection type, operating at speeds consistent with heavy duty continuous service, namely, 514 rpm. Each engine is equipped with the standard accessories normally furnished in an up-to-date Diesel power plant, and additional control equipment will be installed in the near future in order to provide better service to a community which has only recently become impressed with the advantages of Diesel power.



Close-up of the two 75 hp. Worthington Diesels which have carried the utility load at Kealakekua since 1931.

The two 3-cylinder engines and the 6-cylinder unit are of similar construction, rated at 25 hp. per cylinder, and were selected with due consideration for interchangeability of parts. Such a feature is of tremendous importance to the small power plant located so remotely.

The Board of Directors and the community are to be congratulated upon their success and faith in the project. It is anticipated that this utility will continue to grow and there is every reason to believe that the additional installation and the extension of Diesel power throughout the famous Kona Coast of the island of Hawaii will be as successful in the future as it is at present.

ITALIAN DIESEL RAILWAY NOTES

By ANTONIO GIORDANO

As has already been announced, in addition to the six electric streamlined trains ordered by the Società Italiana Ernesto Breda at Milan, the Italian State Railways Administration has ordered nine Diesel engined streamlined trains from the Fiat Co. at Turin. The first of these trains has undertaken its trials on the Turin-Novara railway, reaching a speed of 162 km. per hour.

Italian railway rolling stock builders had already taken up the question of building light and speedy rolling stock when both the Breda and the Fiat completed Diesel engined rail cars capable of reaching 140 km. per hour.

The question of transmission, it is claimed, has been the chief problem to settle in this connection in order to reach and maintain the speeds exceeding 160 km. per hour required. In the case of these particular streamlined trains direct mechanical transmission has been adopted to connect the Diesels to the wheels. Vulcan Sinclair traction type hydraulic couplings with Wilson epicyclic gear boxes have also been used very successfully in this service.

The Fiat Diesel engined streamlined train consists of three cars carried by four bogies in such a way as to realize a single articulated unit measuring about 60 meters in length. The three cars are in communication through corridors protected by double leather bellows.

Of the four bogies the two extreme ones each carry a motor group. The streamlined train is driven by two Fiat 12-cylinder V-type Diesel engines of the normal power of 400 hp. at 1,500 rpm. each. The two motors, as in the case of the rail cars, are driven at the same time by a single guide. The train may be driven from either end. The transmission to the wheels is made by means of a speed exchange with four strokes, free wheel, stroke inversion and reduction devices. All the wheels of the four bogies are provided with pneumatically driven brakes.

The body of the train is built of steel with the same system as the rail cars now in service on the lines of the Italian State Railways.

The first car of the streamlined train is divided as follows:

a. Driver's compartment (the second driver's compartment of the other motor is in the third car).

b. Motor-electric general-compressor set for the output of electricity and of the compressed air for the operation of the various services.

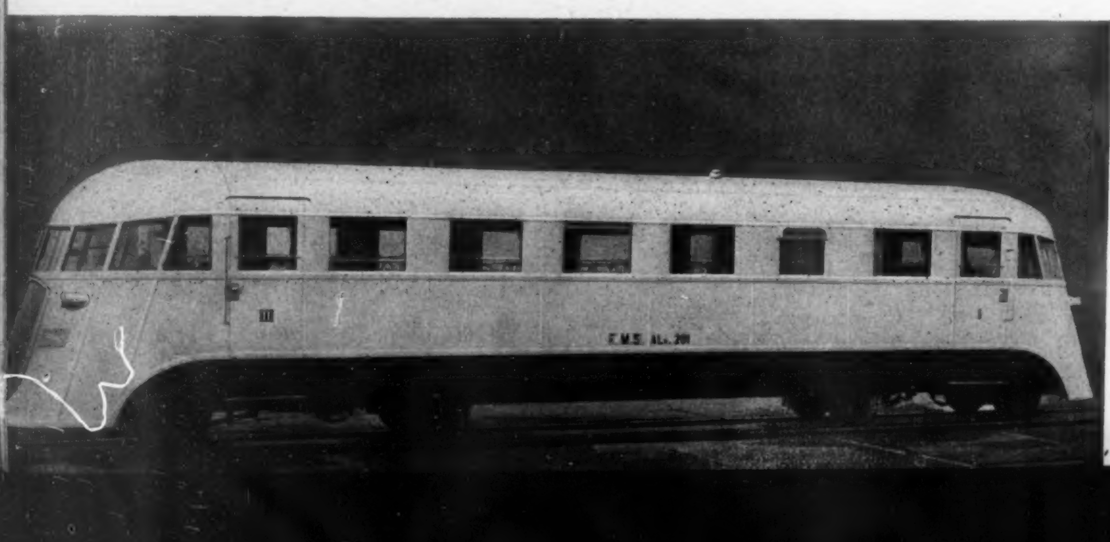
c. Mail room.

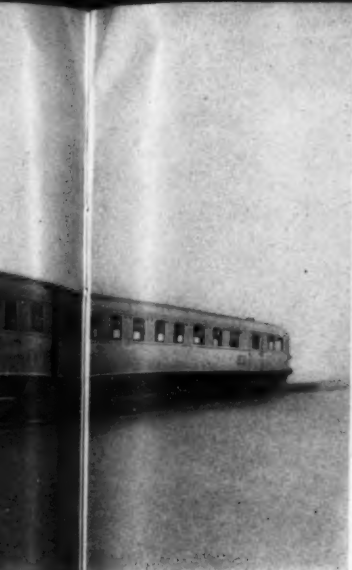
d. Baggage room, having an area of 11 square meters (as in the ordinary trains baggage cars, two large openings on the side of the car render easy loading and unloading of luggage).

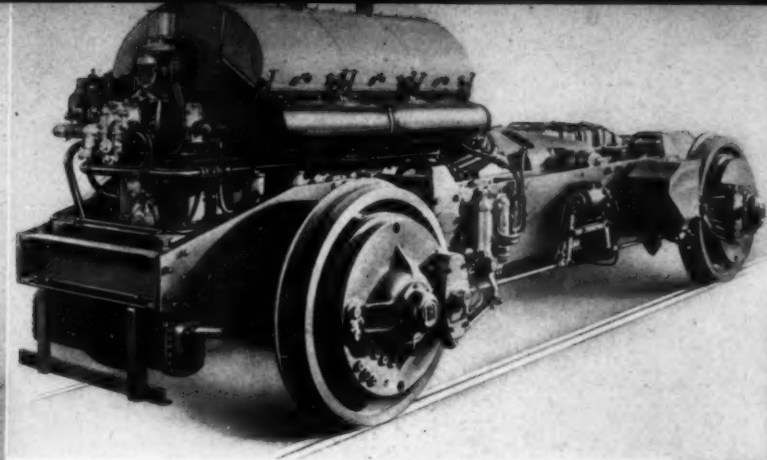
e. Kitchen with storeroom provided with refrigerating machinery.

f. Toilet and storeroom for the conductors and personnel.

The other two cars are employed for the carriage of passengers. In the central car, where there are all seating accommodations, there are 36 places for first class passengers in comfortable double or single arm chairs in green velvet. Special tables allow the passengers to be served during meal time in their own seats. In the central car, in addition to the seating accommodation, there are two hand luggage stores, a special compartment for the restaurant service, toilet at the disposal of passengers and two rooms for the air conditioning plant. In the third car there are 42 seats for passengers in red velvet, arranged as in the second

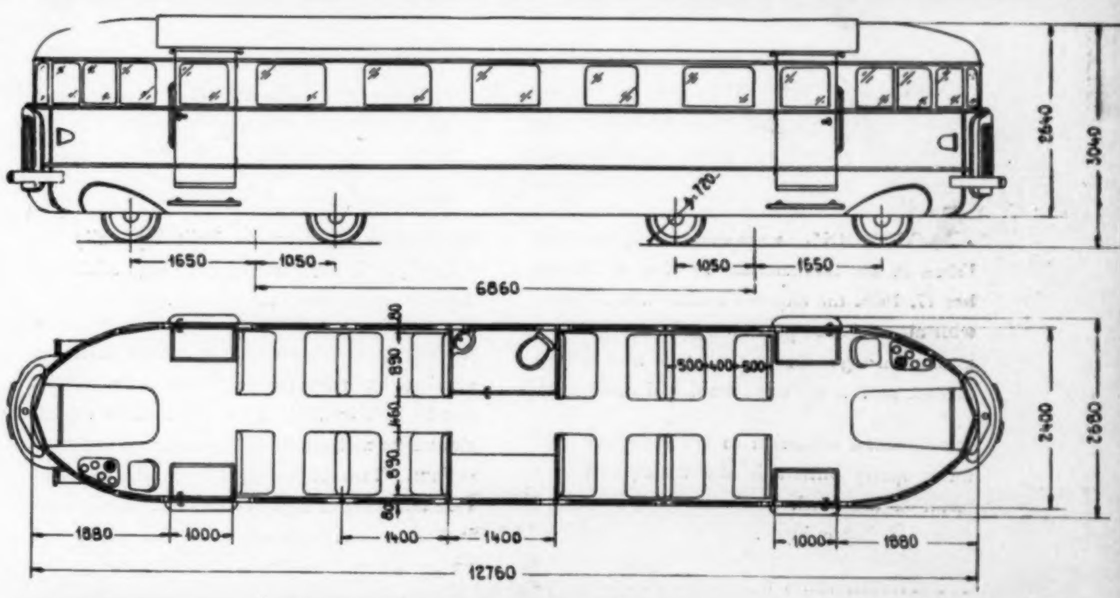






Interesting view of driving bogie on Fiat streamlined Diesel train.

car with removable tables. In addition to such seats, there are in the third car hand luggage compartments, toilet, service rooms and a second driver's cabin separated from the passenger compartment by a wall. An air conditioning plant of the system employed on the American streamlined trains has been provided. The air is drawn from outside through ventilators driven by a Diesel electric generating set, and is purified through filters and wetted and refrigerated if necessary. In winter time the air is heated by a steam system. The boiler for the output of steam for heating purposes has been fixed in the third car driver compartment. Indirect lighting has been provided in all the passenger compartments.



The main dimensions of the Fiat Diesel engined streamlined train may be summarized as follows:

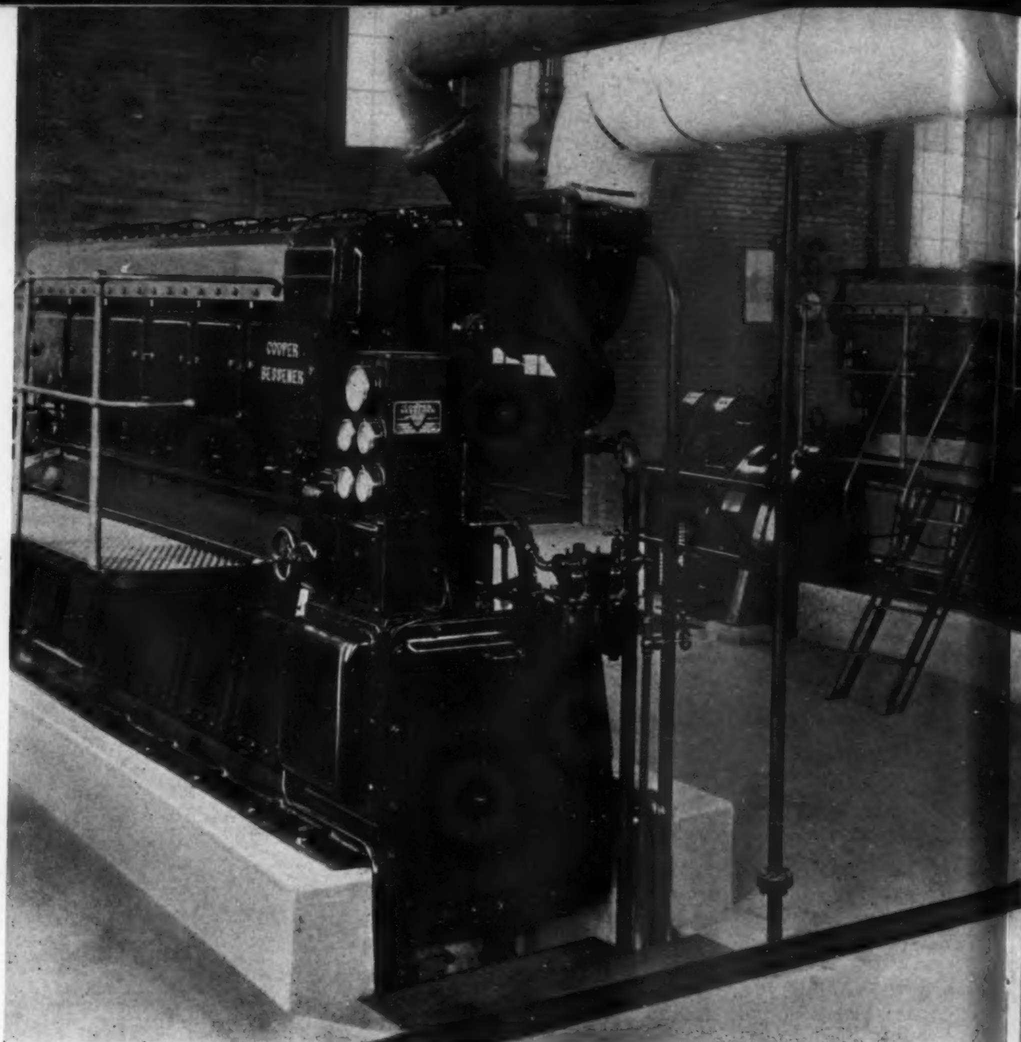
Length	59.190 mm.
Breadth	2.700 mm.
Weight (empty)	82 tons
Weight (fully loaded)	92 tons
Total power of 2 Diesel engines	800 hp. at 1,500 rpm.
Fuel consumption gr/km.	1,300

These Diesel engined streamlined trains may be considered as the result of the experience made by Italian railway engineering with the operation of Diesel engined rail cars, the success of which has gone beyond the frontiers of Italy. Orders have come also from Brazil and Spain, in addition to the petrol rail cars ordered by Russia, as it can be seen from the following schedule:

. . . . *And now please turn to page 76*

Some of the Diesel railway equipment being produced in Italy for domestic and colonial service.

MORE WATER FOR LESS MONEY AT CONNERSVILLE INDIANA



ACCORDING to accountants' figures published in the Connersville Tribune of December 17, 1936, the city of Connersville, Indiana, with about 12,000 population, is saving $31.80 a day through the use of two new Diesel-Electric units at the city's municipal waterworks.

A substantial reduction in fire insurance rates for property owners is also anticipated as a result of the much better fire protection that is now being enjoyed.

The Tribune states that Connersville's power for water pumping purposes formerly cost the city $46.00 daily. The total daily cost of operating the new municipal water pumping power plant is placed at $14.20! . . . and this figure is said to include labor, overhead and depreciation. The water service which it provides is a definite improvement in every way. Three pressure pumps have been installed but only one is at present being used . . . and that one pump is delivering more water than was ever possible under the former arrangement.

The two Diesel engines, which were built by Cooper-Bessemer, are rated at 363 hp. each, at 400 rpm. They drive two 250 kw., 2300 volt Westinghouse generators, built especially for this installation and having extra-high efficiency. The engine mufflers are Maxim.

A Cooper-Bessemer compressor unit furnishes starting power for the two Diesels. It supplies two 24 inch by 75 inch air tanks whose capacities assure at least six starts under normal conditions. Two Graver 10′ 6″ by 24′ tanks provide adequate storage for fuel oil. Equipment includes a Northern rotary fuel oil pump and an auxiliary two-stage Gardner-Denver motor-driven air compressor.

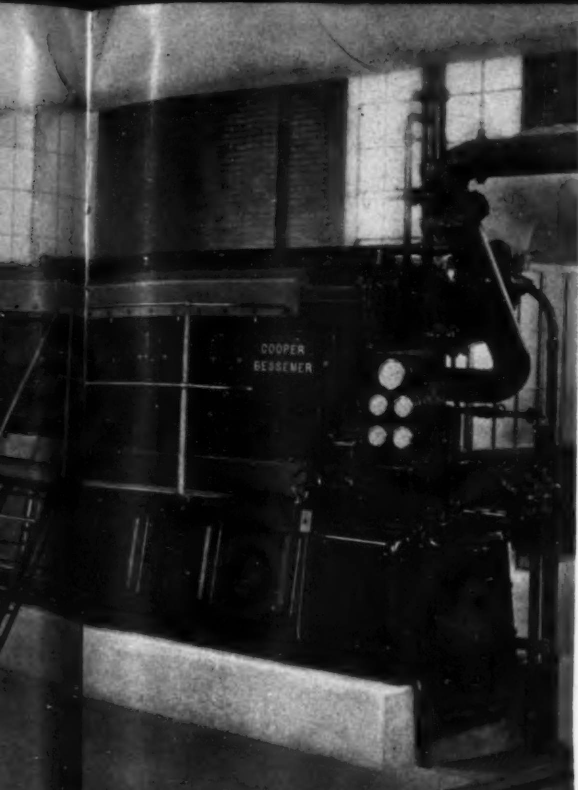
A constant supply of clean oil is assured through the use of a Gould's Hydroil Oil Purifier. A Viking 50 Gallon per minute Fuel Transfer Pump and a 10 Gallon per minute hand operated pump, effectively handle the transfer of fuel oil.

Two Gardner-Denver 1½-inch pumps, driven by 5 hp. motors, supply 125 gallons per minute of softened cooling water for the engines. Two Gardner-Denver 2-inch pumps, driven by 3 hp. motors, supply raw water to the jacket water coolers. These pumps are inter-connecting in their respective systems, for emergency use.

A special Rainbow Water Softener, of 10 gallon per minute capacity provides softened make-up water for the cooling system. Griscom-Russell Heat Exchangers cool the softened water. Thus, a constant supply of softened cooling water is circulating and recirculating through the engine's water jackets . . . assuring freedom from scale and corrosion and effective cooling. A 100 gallon expansion tank, with a Viking low-water alarm signal, is provided in the soft-water cooling system.

The Diesels operate in parallel and each is equipped with a motor-driven synchronizing device which is manually controlled by push buttons from the switchboard. The engines have both manual and motor controlled governors and their speeds may be varied through a narrow range for synchronizing purposes.

Each engine's lubricating system is equipped with a pressure operated Viking electric alarm which gives an immediate warning should the lubricating oil pressure drop. Each engine is equipped with a Cooper-Bessemer duplex lubricating oil filter with edgewise elements.



The V-belt driven exciters are mounted over the outboard bearings and have jack-screw adjustment for maintaining proper belt tension. With the exciters above the outboard bearings, and the fully enclosed guarding, a welcome saving of space and a more compact and accessible unit is achieved . . . far better to look at and work about than were the exciters off to one side, as is customary.

American air cleaners for the two Diesels are located on the outside of the building, at a convenient level for cleaning, when necessary.

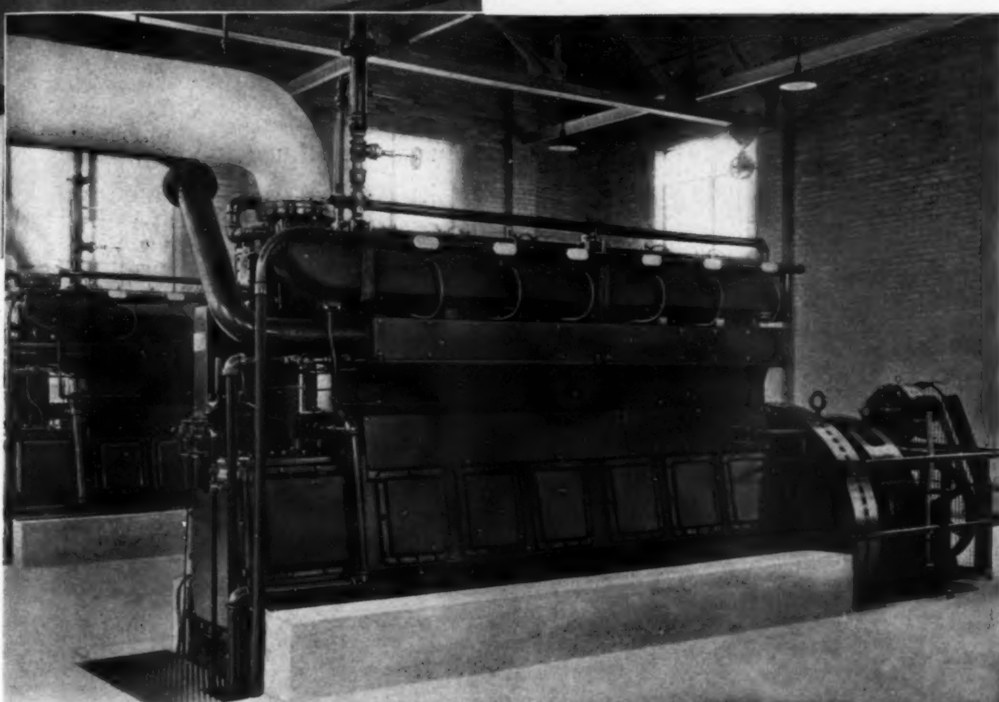
Practically all of the auxiliary equipment, including pumps, air tanks, compressors and Heat Exchanger Company lubricating oil coolers, are located in the basement of the building, between the foundations of the Diesel engines.

This naturally makes for a cleaner, clearer engine room, free of excess piping and also a far more compact and easily accessible engine set-up. The floor level of the auxiliary equipment is the same as that of the pump pit.

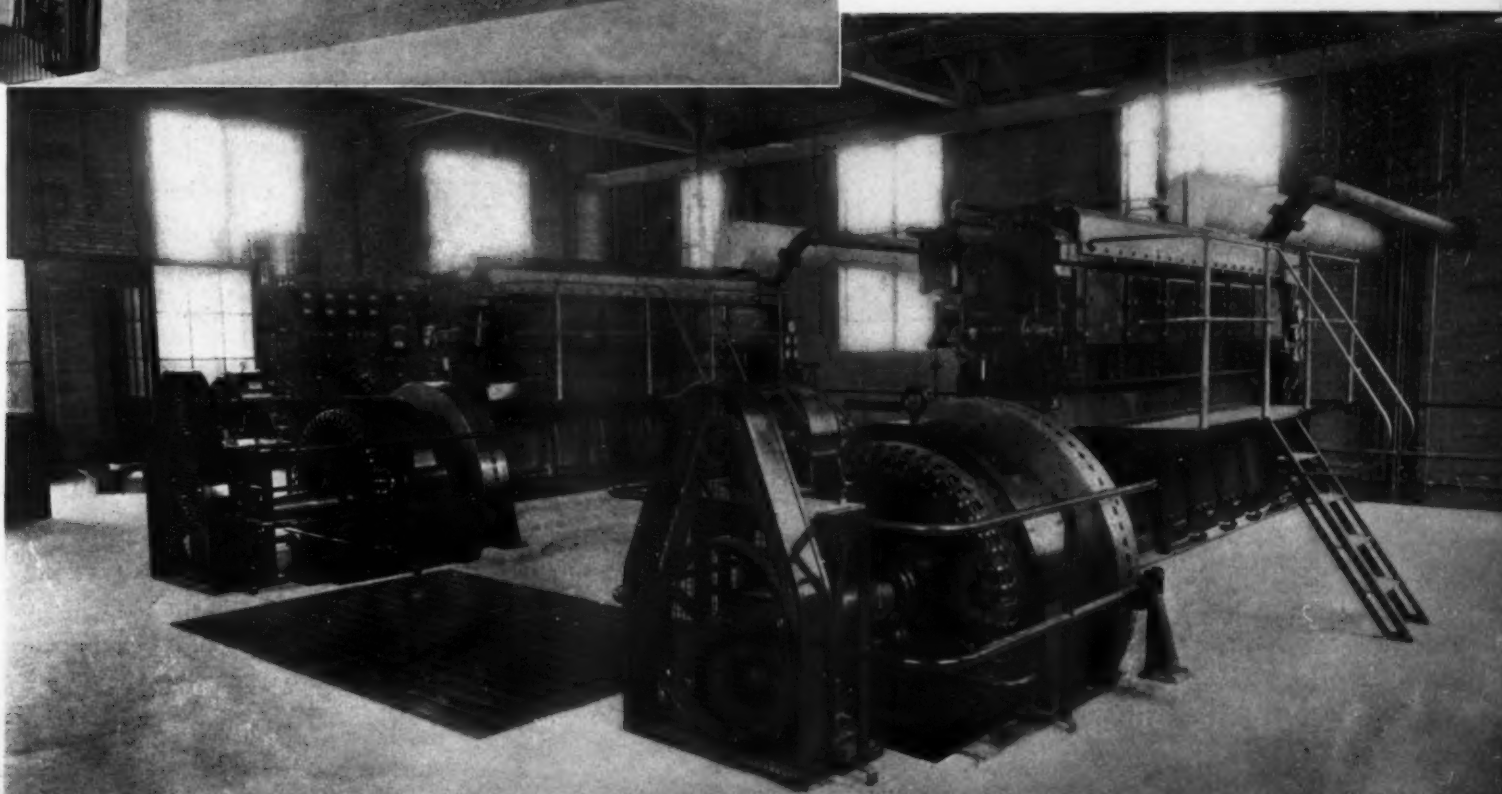
With this equipment the City of Connersville is prepared for whatever water pumping requirements it may meet for some time. Those connected with its installation and maintenance are satisfied that in selecting Diesel power they have not only kept pace with water pumping plant progress but have at the same time rendered a valuable service to the community . . . which service is reflected in the savings already quoted and those anticipated in insurance rates.

The Cooper-Bessemer Corporation, having complete charge of engine and engine auxiliary installation, aimed to make it a most modern one from every standpoint — efficiency, accessibility and all-around perfection. In fact, it was to be a show place — a concrete example of what could be done, and what was being done, in the way of twentieth century municipal power plant installations. From all indications they have succeeded admirably.

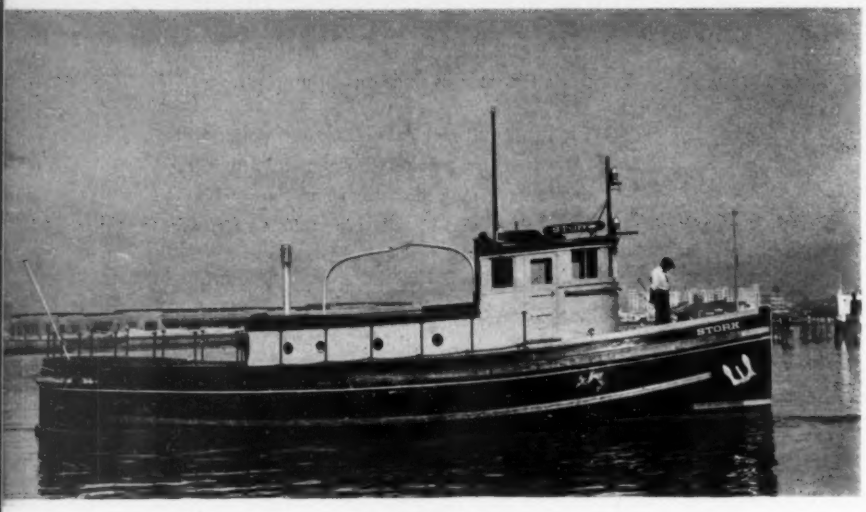
A progressive city government, headed by William F. Dentlinger, Mayor, is responsible for the practical steps taken to provide this modern municipal water pumping plant for the City of Connersville.



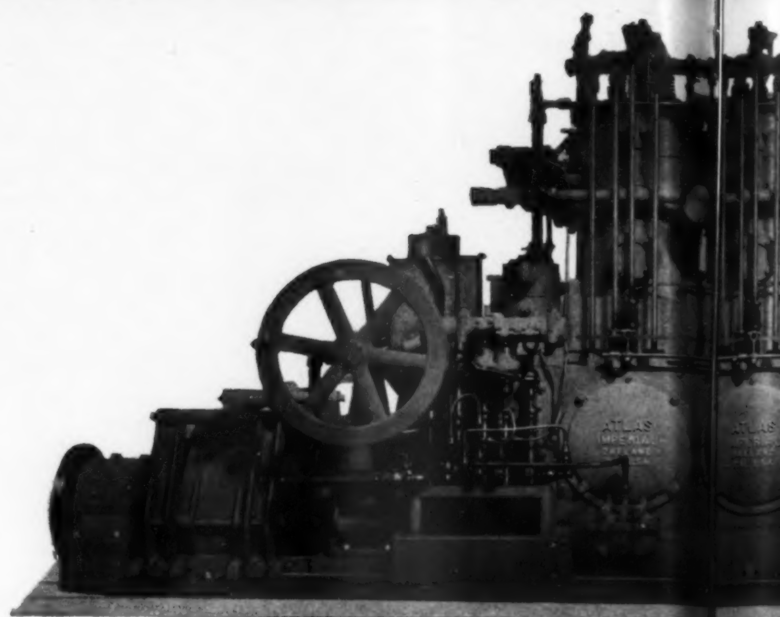
Two Diesel-Electric Units . . . Cooper-Bessemer, Type JT-6 . . . direct driving 250 kw. Westinghouse generators in the city waterworks at Connersville, Indiana.



Alaska Packers' Fleet Predo



THE STORK
is powered by a 3 cylinder, 9" x 12", Atlas Imperial Marine Diesel rated at 75 H.P.



THE EAGLE
is powered by a pair of 3 cylinder, 7½" x 10½", Atlas Marine Diesels rated at 50 H.P.

THE TEAL
carries a 4 cylinder, 7½" x 10½", 70 H.P. Atlas Imperial Marine Diesel.

JUST previous to the salmon run, the boats of the Alaska Packers Association leave San Francisco Bay, headed for their canneries in Alaska. They are laden with supplies to last throughout the canning season and aboard are the cannery workers who man the boats and staff the salmon canneries.

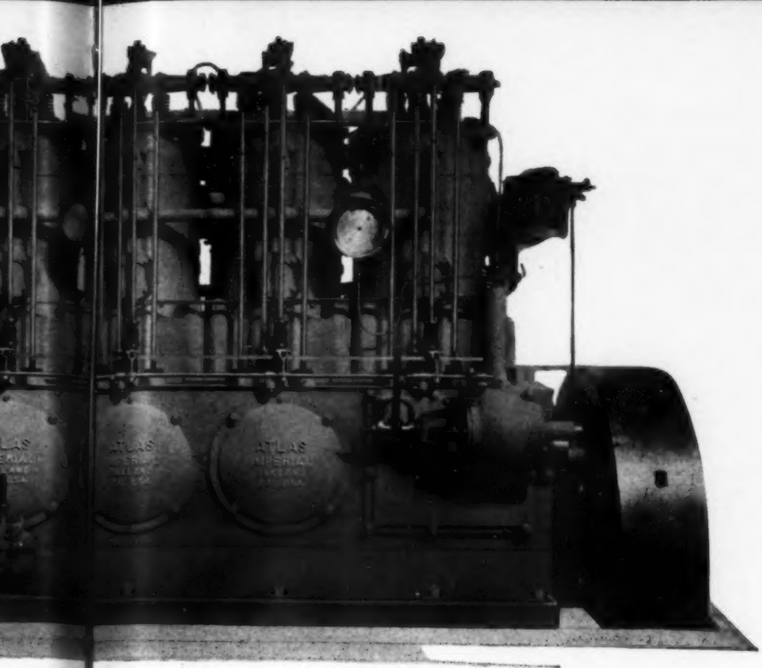
Late in the fall these same boats return to San Francisco Bay, bringing back cannery workers anxious to get home and hundreds of thousands of cases of canned salmon—the entire season's pack. From the time the Alaska Packers boats sail Northward until they return, they are operating in waters far removed from their base of supplies.

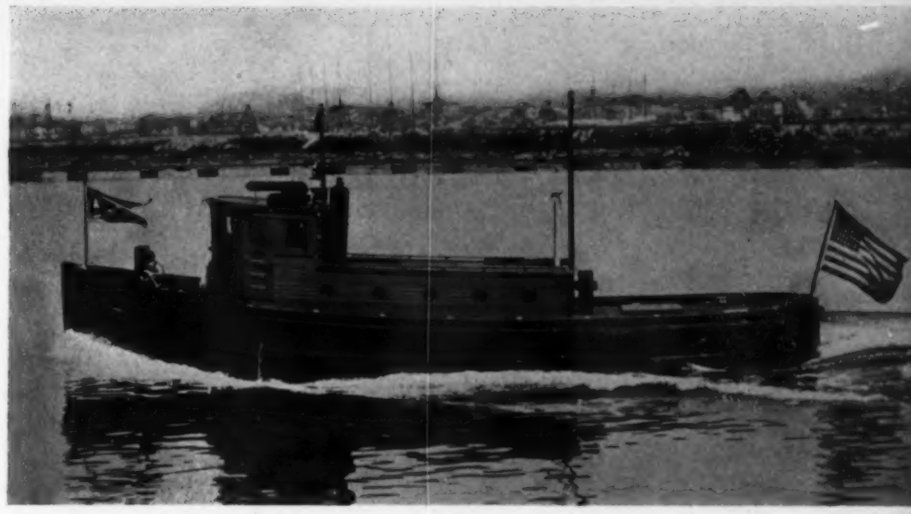
Everything that can be anticipated has been done to insure the unbroken continuity of the season's operations. Any cessation during the salmon run is costly. That is the reason that the lion's share of the Alaska Packers Diesel powered boats have Atlas Diesels in their holds. They have a long estab-

ATLAS IMPERIAL DIES
OAKLAND, CALIFORNIA •

ATLAS IM

edominantly Atlas Diesel!





THE RAIL
is another of the Alaska Packers' boats powered by a 4 cylinder, 7½" x 10½", 70 H.P. Atlas Imperial Marine Diesel.

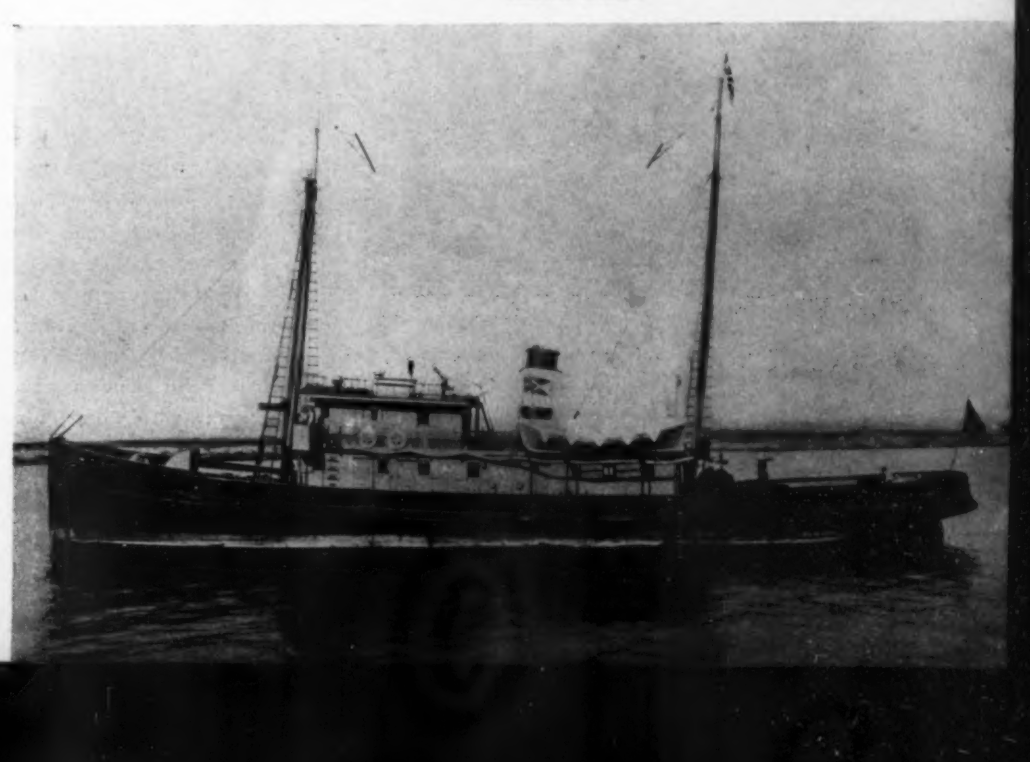
lished reputation for absolute Dependability among all Pacific Coast fishermen.

Pictured here are six of the seventeen Atlas Diesel powered cannery tenders which keep a steady flow of salmon moving to the canneries. With Diesel power, cannery tenders have just twice the cruising radius as gasoline powered boats for Atlas Diesels burn just half the number of gallons of fuel as gasoline engines of similar power. Then too, the cost of Diesel fuel averages just about a third the cost of gasoline, so the Atlas Diesel powered boats operate at about 1/6 the cost of gasoline engined vessels.

Such economy of operation is naturally directly reflected in the fair price at which Alaska Packers canned salmon is always available to the housewives of the world. The reliability and dependability of their Atlas Diesels play no small part in bringing this Alaskan delicacy to your table, fresh and flavorful.

THE BRANT
is powered by a 4 cylinder, 10" x 13", 135 H.P. Atlas Imperial Marine Diesel.

THE CHILKAT
is propelled by an 8 cylinder, 13" x 16", 500 H.P. Atlas Imperial Marine Diesel.



AL DIESEL ENGINE CO.
A • MATTOON, ILLINOIS

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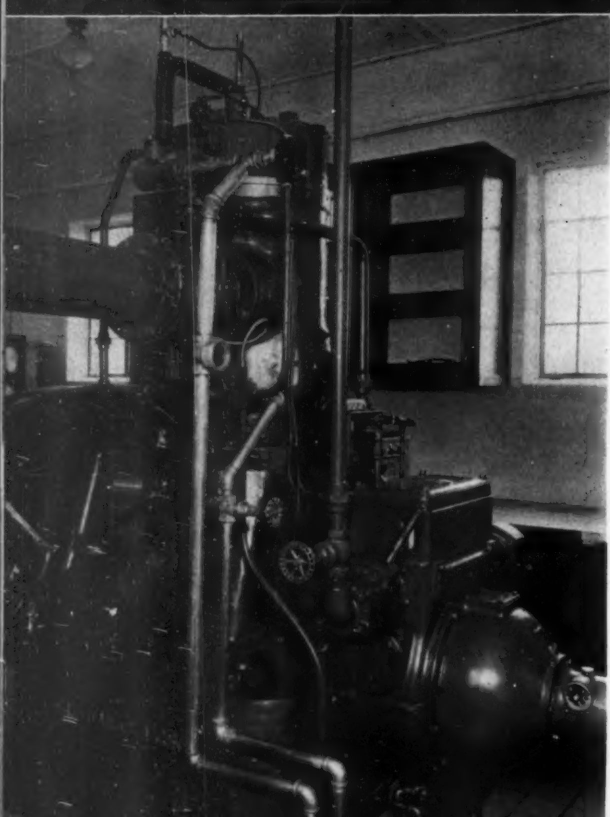


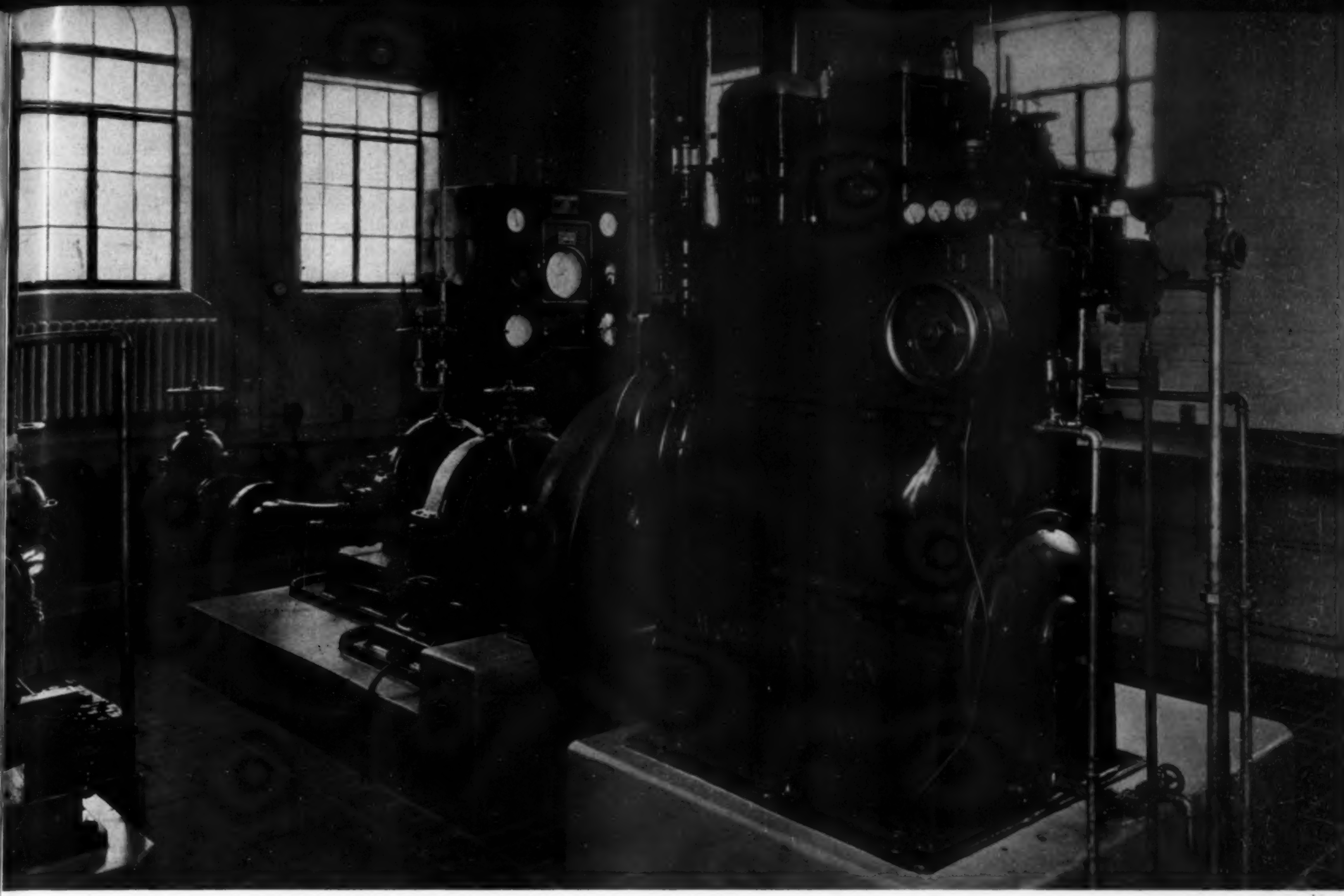
Close-up view of the Fairbanks-Morse Diesel at Harwich and (above) a general view of the Cotuit engine room, showing the Worthington Diesel and Buda gasoline standby unit.

HARWICH AND COTUIT, MASSACHUSETTS

New Diesel Waterworks in Two Cape Cod Towns

Up to the year 1936, the citizens of Harwich and Cotuit on picturesque Cape Cod relied upon their own wells for drinking and service water. At that time it was decided to install modern municipal pumping stations in both towns and it is not surprising that, after due investigation, Diesel engines were selected to furnish the required power in both cases. Both plants were designed and constructed through the collaboration of Whitman & Howard, Engineers, Gustavo Preston Company and the F. A. Mazzur Company, all of Boston, Massachusetts. The signal success of both plants is a tribute to the careful planning by these parties as well as to the Diesel equipment which they installed.

The Harwich station has a Fairbanks-Morse single cylinder, two cycle engine rated at 60 hp. at 360 rpm., driving a four inch, Pennsylvania, single stage, waterworks type centrifugal pump. Engine and pump are connected through a Falk herringbone speed increasing gear and Falk flexible coupling. The centrifugal pump is equipped with a patented balancing port which



Quarter view of the Worthington pumping unit at Cotuit. Below: The Falk speed-increasing gear appears just beyond the flywheel of the Fairbanks-Morse Diesel at Harwich.

equalizes the pressure at the eyes of the double suction impellers and maintains hydraulic balance at all times regardless of any variations which may occur in suction conditions. Standby service is provided by a duplicate pump, gasoline engine driven. The capacity of each unit is 500 gpm. against a dynamic head of 223 feet. Perhaps the most important item in the whole set-up is the cost of operation. With Diesel oil at 6 cents per gallon, the cost of pumping 1,000,000 gallons is the remarkable figure of $4.46 for fuel.

Starting air is furnished by two Quincy two stage, air cooled compressors, one Ideal motor driven and the other operated by a Wisconsin gas engine. A Maxim DO-4 silencer is fitted to the Diesel exhaust.

The power at the Cotuit plant is also 60 hp. furnished by a two cylinder, four cycle Worthington Diesel operating at 600 rpm. The same type and size of pumps and speed increasing gears are used as at Harwich, although the flex-

ible couplings in this case are Morse. All Quincy compressor units at both stations are arranged with automatic stops which operate when the desired air tank pressure is reached. Starting, however, is manual. With a dynamic head of 217 feet and oil at 6 cents a gallon, the fuel cost per 1,000,000 gallons of water pumped at Cotuit is $4.33, or a saving over the Harwich figure corresponding closely with the difference in pumping head of the two stations.

Water is obtained from four gravel packed wells at each town, the average depth of these being approximately forty feet. A 54 inch outer casing was sunk and then a strainer was set in the water-bearing stratum at the bottom of a 30 inch inner casing. Graduated gravel was then packed between the inner and outer casings, after which the outer one was withdrawn, leaving 12 inches of gravel surrounding the inner, thus effecting infiltration of the water which is of excellent quality in both cases. Incidentally, gravel packed wells are comparatively new departures for water sources in Massachusetts, previous practice having consisted mainly of driven wells of about 2½ inches diameter connected by a common suction to the pumping station with rarely more than a 10 foot suction lift. The new type has proven highly successful.

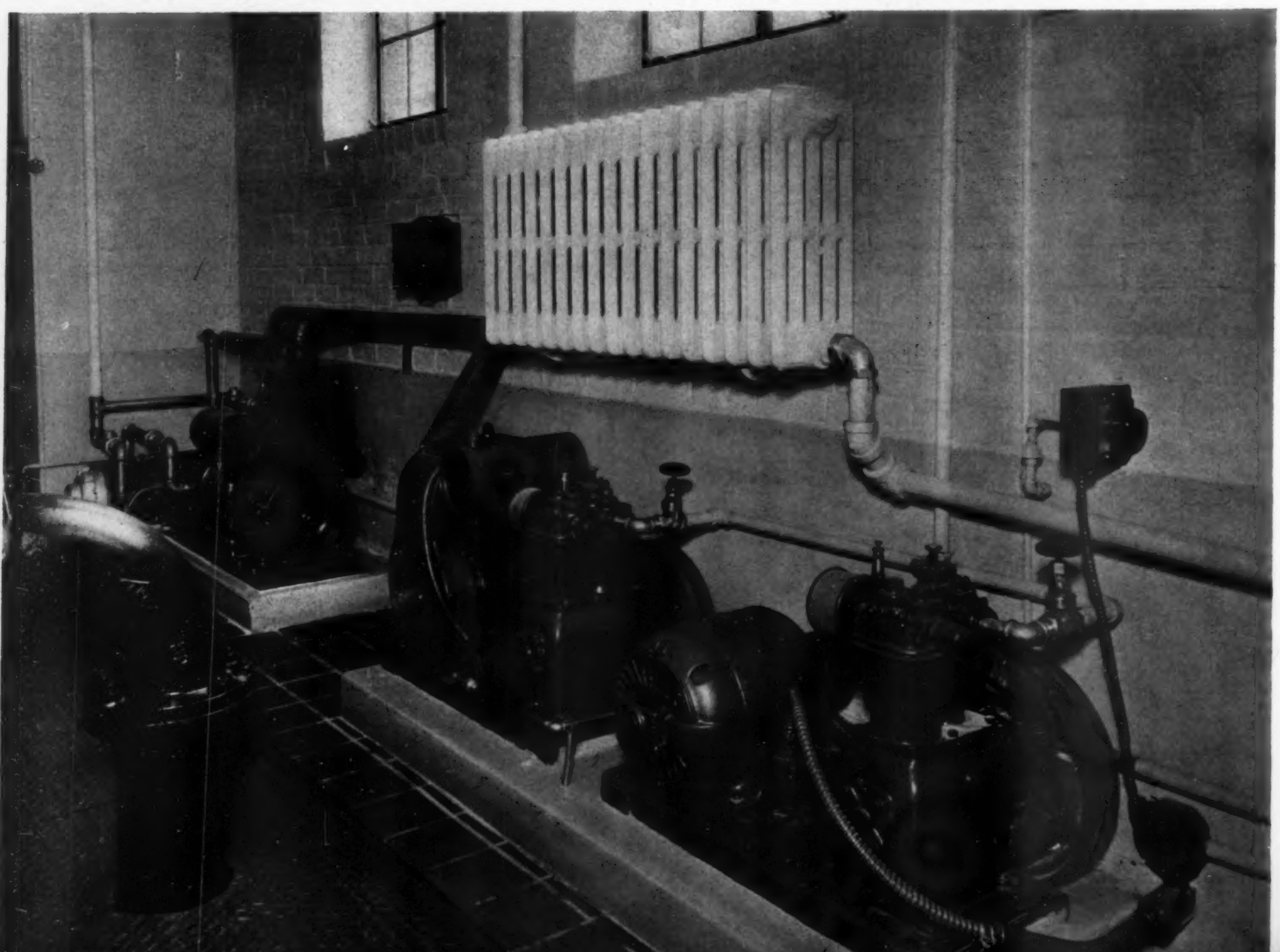
The suction is connected to a "sand chamber" which has a water-tight baffle in the middle which serves the double purpose of preventing sand from entering the pump and permits air to be separated from the water. The top of this chamber is piped to a Nash Hytor vacuum pump which is electrically driven. A float switch automatically controls this pump when the water in the "sand chamber" drops below a predetermined level. Hence, the main pumps are always primed and ready to start. A low-level float acts as a safeguard and automatically shuts down the station in the event of the water becoming too low in the "sand chamber."

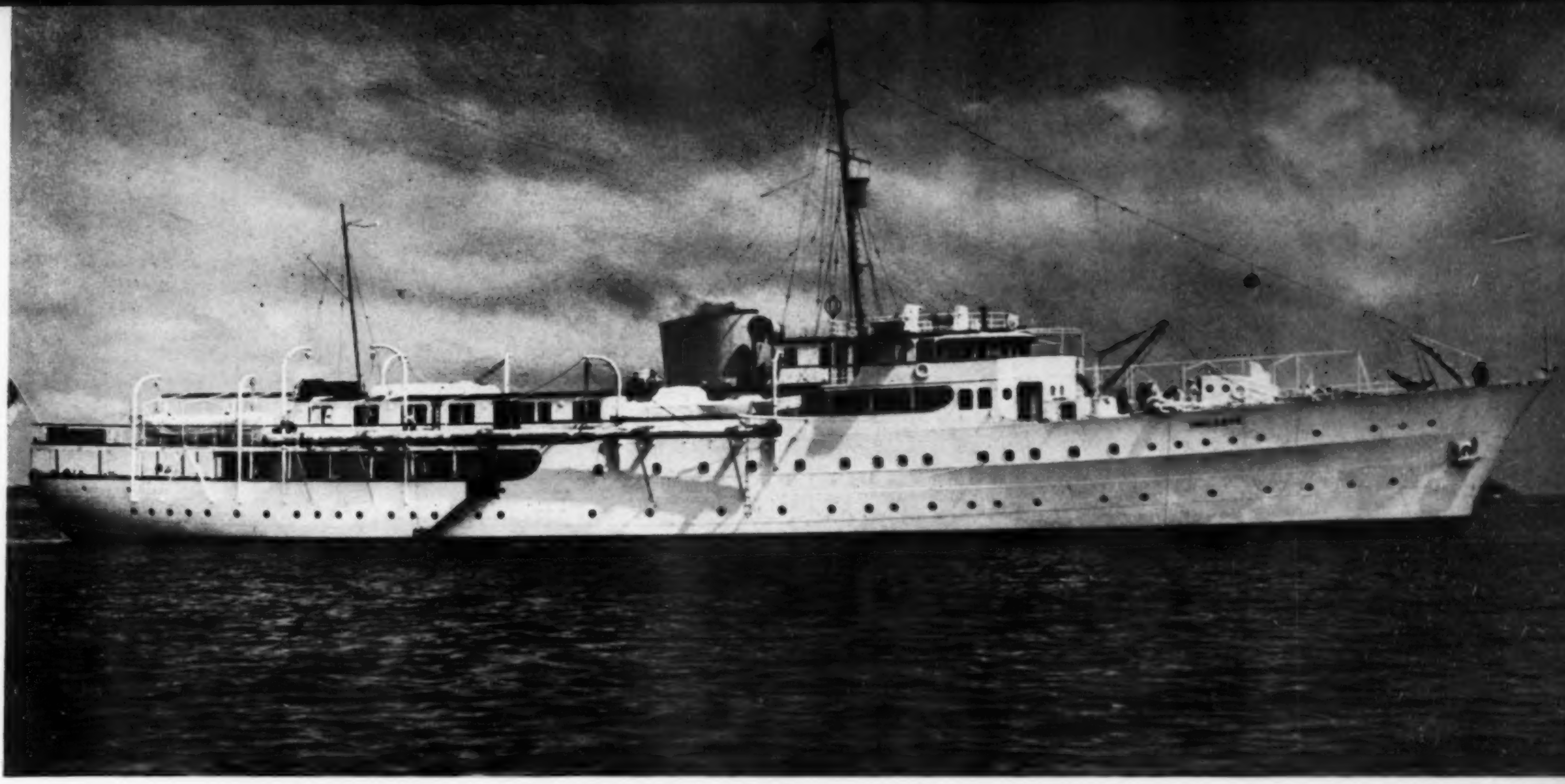
Both the Harwich and Cotuit Diesel pumping stations are practically identical in so far as operating conditions are concerned. Their capacities and machinery layouts are likewise similar. Both operate on the basis of manual start and automatic stop so that the Superintendent of the Water Department can also act as operating engineer and does not have to be in attendance when the standpipe is full or should trouble develop. The standpipes of both towns have a capacity of 250,000 gallons each and are equipped with altitude valves. When the tank is full this valve closes and builds up a back pressure at the station which automatically shuts down the pumping engine. Thermostatic elements on all bearings, gears and engine cooling systems accomplish the same purpose if occasion demands. The Sundh Electric Company furnished the automatic features of the two plants, which are protected against practically every emergency common to such operation. The gasoline engine standby units previously mentioned and connected to duplicate pumps were supplied by the Buda Company.

Both the Harwich and Cotuit buildings which house the pumping equipment are attractively designed. They are of brick construction with tile floors. A partition closes one end to form an office where the Water Department keeps records, issues bills, and conducts meetings of the Board members in addition to providing the customary Superintendent's office.

While these Diesel plants are relatively small on the basis of actual horsepower, they are splendid illustrations of dependable, economical municipal installations. Without doubt many other communities could profit from similar installations properly engineered.

Duplicate Quincy compressor sets, one motor driven and the other gasoline engine powered, which furnish starting air for the main engines at both Harwich and Cotuit Diesel pumping stations.





The 263 ft. Diesel yacht "Philante," owned by Mr. T. O. M. Sopwith, and now stationed off Newport, where she is acting as tender for Mr. Sopwith's cup challenger "Endeavor."

LONDON LETTER NO. 21

By G. R. HUTCHINSON*

ONE of the most interesting recent events in the British Diesel world has been the completion of Mr. T.O.M. Sopwith's M.A.N.-engined motor yacht *Philante,* which, before this note is published, will have been seen by not a few readers of DIESEL PROGRESS. I was fortunate enough to be able to spend a considerable time on the yacht before she left for America and was greatly impressed by her general design, the air of spaciousness in the accommodation, and the excellent layout of the machinery. The *Philante* has the distinction of being the largest Diesel yacht yet built in a British yard and it is fitting that it should have been constructed by Camper & Nicholson, Ltd., who for long have been so closely identified with the construction of power and sailing yachts of the highest quality. The vessel has an overall length of 263 ft., an extreme breadth of 38 ft., and a draught aft of 14 ft. 9 in. Her Thames tonnage is 1,612 tons.

A great deal could be written about the constructional and naval architecutral side of the vessel as well as about her splendid accommodation. When it is realized that there is provision for only five guest cabins, in addition to those for Mr. and Mrs. Sopwith, their son, servants, and the crew, it will be appreciated that the layout of the vessel is along unusual and most attractive lines. Mrs. Sopworth's bedroom, for instance, is no less than 30 ft. long and the living room and dining room are likewise commendably spacious.

Turning now to the machinery, which, after all, is the most interesting part of the vessel from our standpoint, we find that Mr. Sopwith has again favored M.A.N. engines, which, in passing, were imported from Germany. The power of each engine is 1,500 bhp. at 285 rpm. They are four-stroke, trunk-piston, airless-injection units and each has eight cylinders 17¾ in. in diameter by 26 in. stroke. Sea-water cooling of jackets and covers is employed, while the pistons are oil-cooled. The engines are directly reversible and each unit drives its own bilge, circulating water, and forced lubrication pumps. Current for the mechanical ventilation system, the hydraulic electric steering gear, the electrical deck machinery, and other purposes is generated in two Diesel-driven dynamos, each of 90 kw. Each dynamo is driven by an Allen Diesel engine, the set which is primarily intended for use in port being mounted on a spring-insulated base of a type which is more usually encountered in stationary plants than afloat. The set which will normally be employed when the vessel is at sea is mounted on a Mascolite vibration-absorbing mat. There is also a large battery of accumulators for auxiliary service and it is interesting to note that the supply pressure is as high as 220 volts.

I was particularly impressed by the spacious layout of the *Philante's* engine room, despite the moderate size of this compartment. This is well shown in the accompanying drawings of the yacht's machinery space, not the least important feature of the layout being the reasonably good space available for overhauling of the main machinery. The Allen engines are not so fortunately placed in this respect. A surprising omission in the yacht's layout, in the writer's opinion, is the lack of any provision for utilizing waste heat. Although main and auxiliary engines are of the four-stroke type, with a reasonably high exhaust temperature, no

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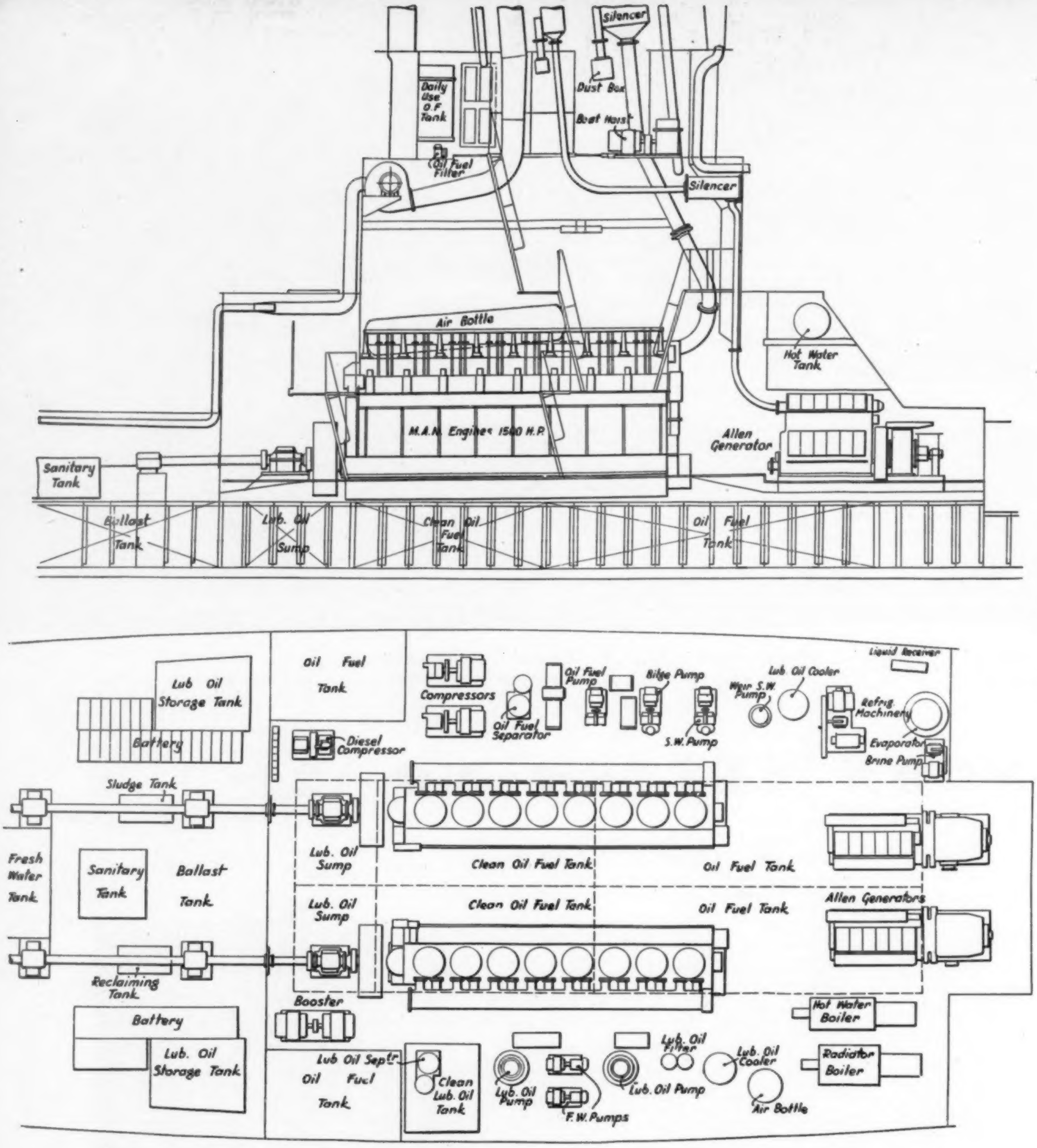
**Editor of "Gas and Oil Power" and Managing Director of the Whitehall Technical Press, Ltd.*



Elevation and plan drawings of the "Philante's" engine room showing the two M.A.N. Diesel engines rated at 1,500 hp. each at 285 rpm. These units are four-cycle, solid injection Diesels with oil cooled trunk pistons. Bore and stroke are 17¾" x 26", respectively.

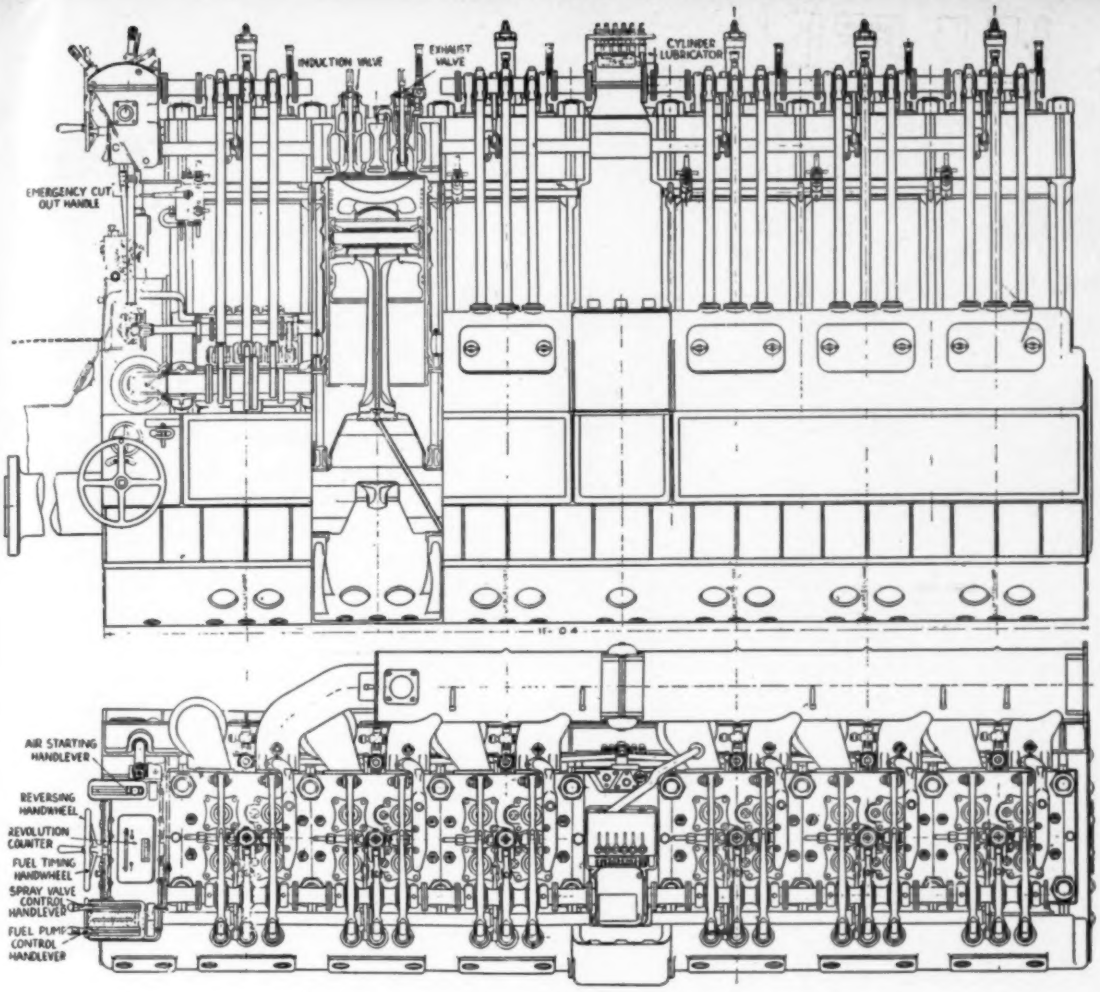
attempt has been made to recover this heat in waste heat-silencer boilers, although, as the engine room plan shows, there are two oil-fired boilers alongside one of the Allen engine sets, one being for the radiator service and the other for domestic hot water supply.

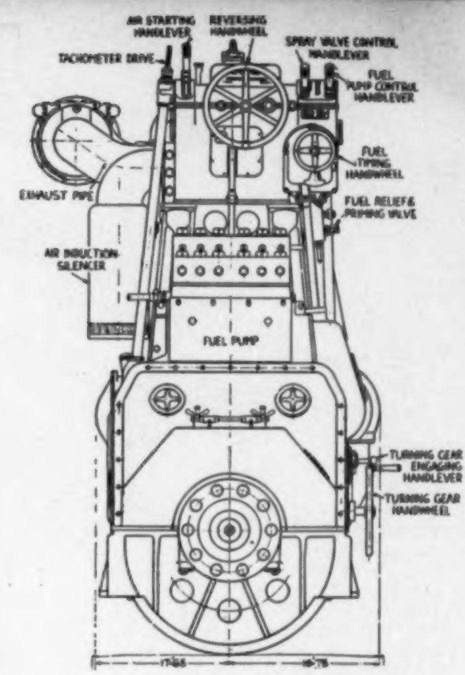
On trial the *Philante* proved to be gratifyingly free from vibration and on a displacement of 1,580 tons achieved a speed of 17.1 knots in fine weather on the normal fuel setting of the engines. As indicating the handiness of the craft it may be mentioned that when "steaming" at 15 knots the order to go astern was given and the maneuver was completed in 2 minutes, 8 seconds. The order from ahead to astern was effected in 47½ seconds on the engines and the ship was under way again in 1 minute, 53 seconds.

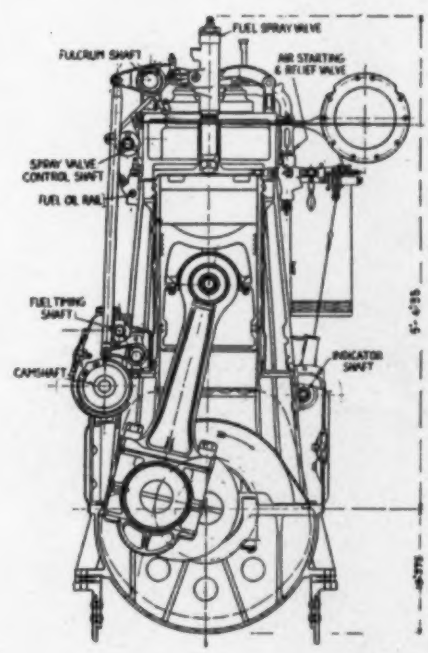
Turning now to matters concerning larger Diesel engines, it is interesting to record that Vickers Armstrongs, Ltd., the important armament concern who are famous as the pioneers of airless-injection Diesel engines and as one of the earliest builders of Diesel engines for submarines, have just introduced a new engine of light weight which is suitable for the propulsion of submarines. This engine is of the four-stroke cycle, airless-injection type, and weighs only 30 lbs. per bhp., developed at normal rating. In its six-cylinder form 600 bhp. is produced at 500 rpm., the cylinders being separate units with very light water jackets. The crankcase is a stiff light structure and the controls are conveniently arranged at the end of the engine. An open combustion chamber is provided with vertical push-rod-operated valves, and the injection arrangements are of Vickers' own design and manufacture.

The engine is intended for smaller submarines, yachts, Diesel-electric vessels, Diesel locomotives, and stationary plants where space and weight are at a premium.

A study of the drawings and notes sent me regarding this engine reveal that the design is







Elevation top and end view drawings of the Diesel recently introduced by Vickers, Armstrongs, Ltd. This four-cycle solid injection engine weighs only 30 lbs. per brake horsepower at normal rating. The engine is intended primarily for small submarines, yachts, Diesel electric vessels, locomotives and stationary plants where space or weight, or both, are at a premium.

particularly clever, especially in regard to the cylinder cover, liner, and jacket arrangements. The accompanying longitudinal and transverse sections are, therefore, submitted for study by the more technically inclined readers. The engine is of 100 bhp. per cylinder at 500 rpm., and is at present being made in six and eight cylinder sizes. The brake mean effective pressure is 92 lbs. per sq. in. and the piston speed about 1,125 ft. per minute. The cylinder covers are all rigidly bolted together to form the upper girder of the engine, the cover being a steel casting with a welded-in combustion plate of forged steel. Each cylinder carries two inlet and two exhaust valves, while the spray valve, it is interesting to note, is unusual in being mechanically operated. Thin steel liners are used with a cast iron piston having a thick, deeply-dished crown. The liner is held up to the underside of the cylinder cover by a deep forged steel ring, to the lower side of which the light steel jacket is attached. Water is transferred from the jacket to the liner at 4 points and the very narrow water space around the liner will be noted with interest.

Space does not allow of our giving a full description of the engine, which has such novel features as built-up welded steel column frames, a very light built-up steel bedplate, with the main bearing cross girders, stiffening ribs and flanges welded thereto, etc. Mention should be made, however, of the stiff and very large diameter crankshaft, which, it will be noticed, is provided with hollow bored pins and journals. Injection arrangements follow Vickers' own design, which is not surprising in view of their pioneer work in this field; it is interesting to note that the common rail system is employed. The fuel consumption is good at all loads.

A Perkins Diesel powered Fordson tractor at work on an English farm.

Courtesy of The Sun (Sydney, Australia)

The builders of the good ship "Georg Stage" never heard of an Atlas Diesel engine, but today, as the "Joseph Conrad," she carries one for auxiliary power—a strange but effective and satisfactory combination.

THE

OF the few remaining authentic "square-riggers," perhaps the most romantic and best preserved today is the fifty-five year old frigate, *Joseph Conrad*. Originally the Danish training ship, *Georg Stage,* this lusty representative of an era past was purchased in 1934 by Alan Villiers, author and adventurer, who saw in her the fulfillment of a long cherished dream: to sail a full-rigged ship in the tracks of the great circumnavigators of the past. The success of this two-year venture with a small crew and sixteen cadets is excitingly and ably told in Villiers' recent book, "Cruise of the *Conrad*." It was at the conclusion of this remarkable voyage around the world that the now famous vessel was listed for sale. Be it ever to her credit and that of her builders that only eight days elapsed before title was transferred to Mr. G. Huntington Hartford, American business man, who saw in her unusual possibilities for a private cruising yacht extraordinary.

Accordingly, in November of 1936, reconditioning was started at the yard of Jacobson & Peterson under the supervision of Sparkman & Stephens, Inc., Naval Architects. Practically no changes were made in the original rigging or weather deck arrangement except for the installation of an electric windlass in addition to the hand type which was not disturbed. Renovations in quarters below were extensive yet simply executed with more thought for comfort and convenience than elaborate fixtures and decoration. Electric lighting replaced the former old style oil lamps and electric refrigeration was installed, since the limitations on available food on board this type vessel were not quite so romantic as most of the other features.

Perhaps the most radical departure from the past was on the problem of auxiliary power, which was intelligently and economically solved with a 160 hp., six cylinder Atlas Imperial Diesel engine, operating at 325 rpm. In addition, two 18 hp. Atlas Diesel generating sets were placed aboard to furnish electrical energy for lighting and power. Other engine room equipment consists of an Ingersoll Rand starting air compressor, a Smith-Meeker switchboard, a Northern rotary, bilge and fire pump and Exide storage batteries floating on the generator lines. Fairbanks-Morse pumps were placed on the fresh and salt water service lines. The galley range was converted to oil firing.

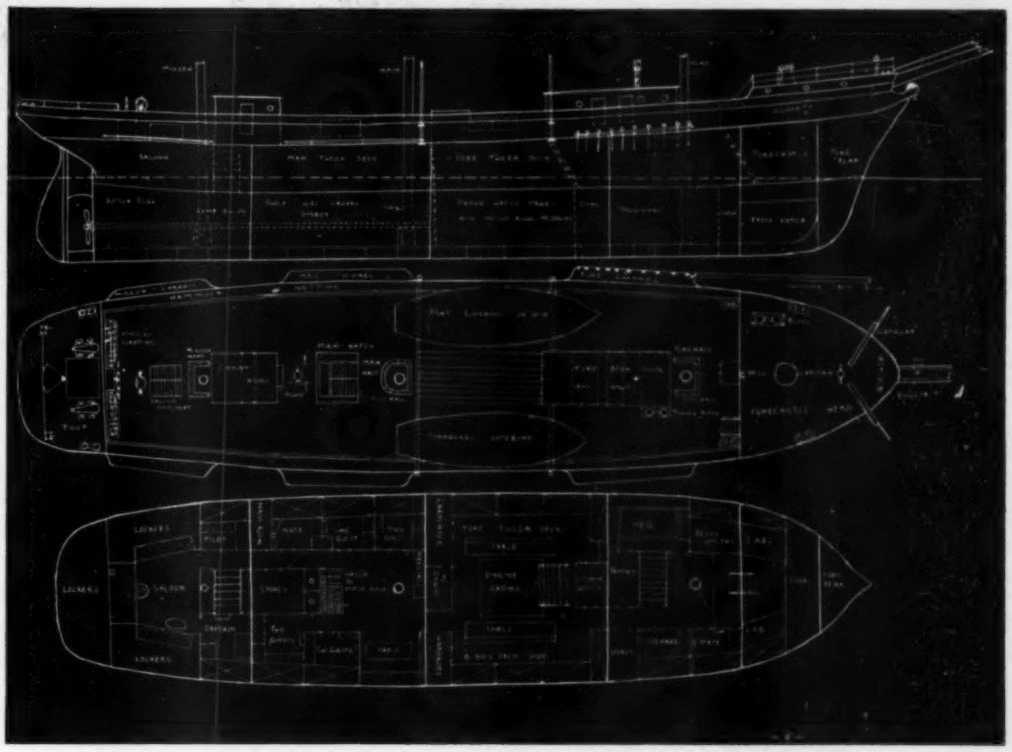
"JOSEPH CONRAD"

Full Rigged Ship Adds Diesel Insurance Against Doldrums and Head Winds

Since Mr. Hartford contemplates cruising in tropical or semi-tropical waters, no arrangements were made for heating. Fresh air ventilation is accomplished by means of a blower which serves all quarters, while the white panelled interior gives a cooling effect.

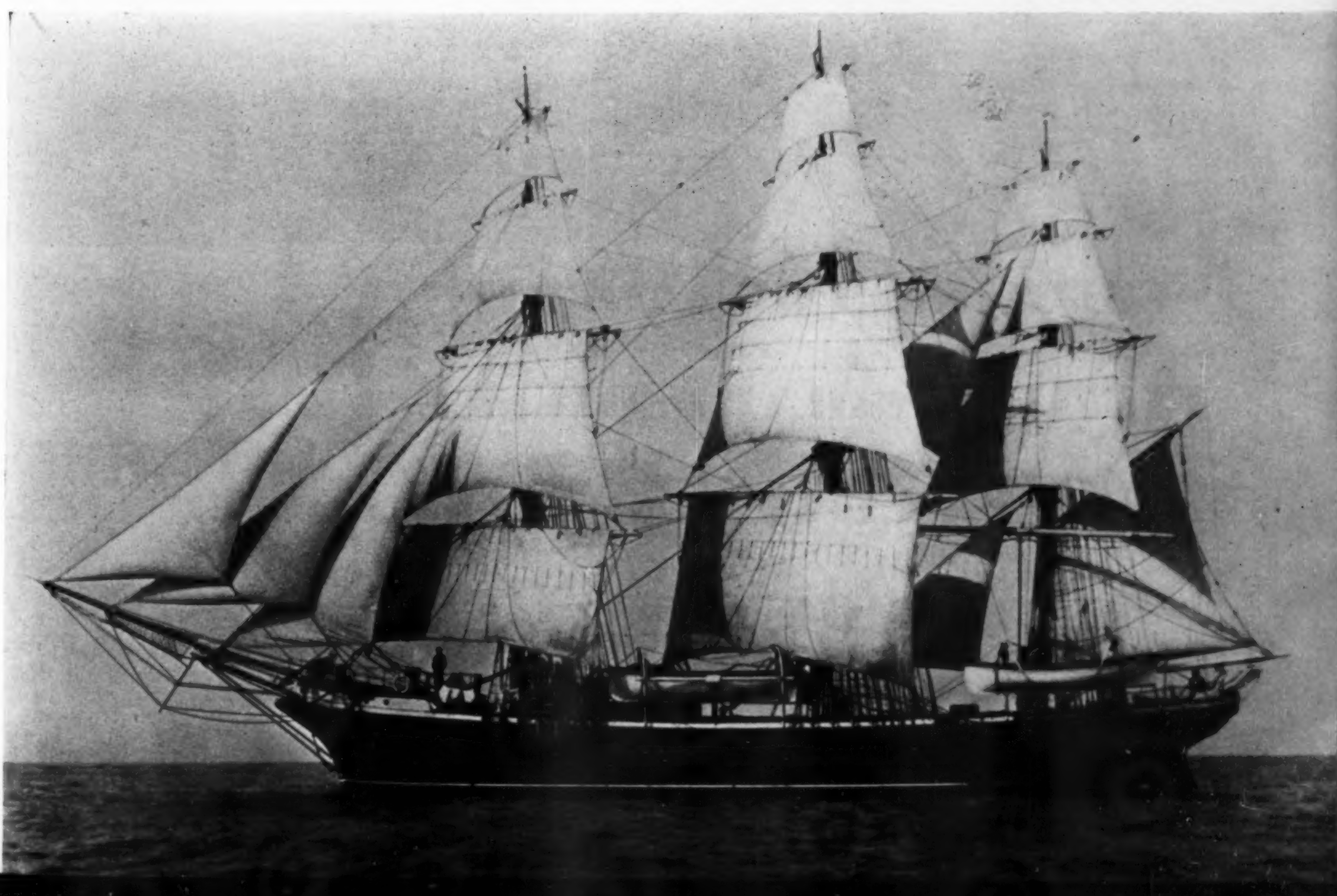
The *Joseph Conrad* is probably the smallest full-rigged ship in existence, with principal dimensions of approximately 100′ x 25′ x 13′, and carries a crew of twenty-three under the able command of Captain Alexander E. Troonin. Captain Troonin is of Russian descent and is especially well suited to his new position, having spent many years on "square-riggers."

Among the guests accompanying Mr. Hartford on his first cruise are Dr. Waldo L. Schmitt of the National Museum, Washington, D. C., and his assistant, Mr. Robert Lunz, of the Charleston Museum, who will conduct biological research among the various ports of call throughout the West Indies. Another distinguished guest is DuBose Heyward, author of "Mamba's Daughters" and other novels and plays, who will gather literary material.



Strange plans for a naval architect to contemplate with a marine Diesel in mind, but Sparkman & Stephens, Inc., effected the conversion with great success.

Plans and photograph below through the courtesy of Alan Villiers.



Freddie Bartholomew, Spencer Tracy and Lionel Barrymore at the helm of their Cooper-Bessemer Diesel powered Gloucester fishing schooner, "We're Here," formerly the "Oretha F. Spinney."

"CAPTAINS COURAGEOUS" FILMED ABOARD DIESEL AUXILIARY GLOUCESTER SCHOONER

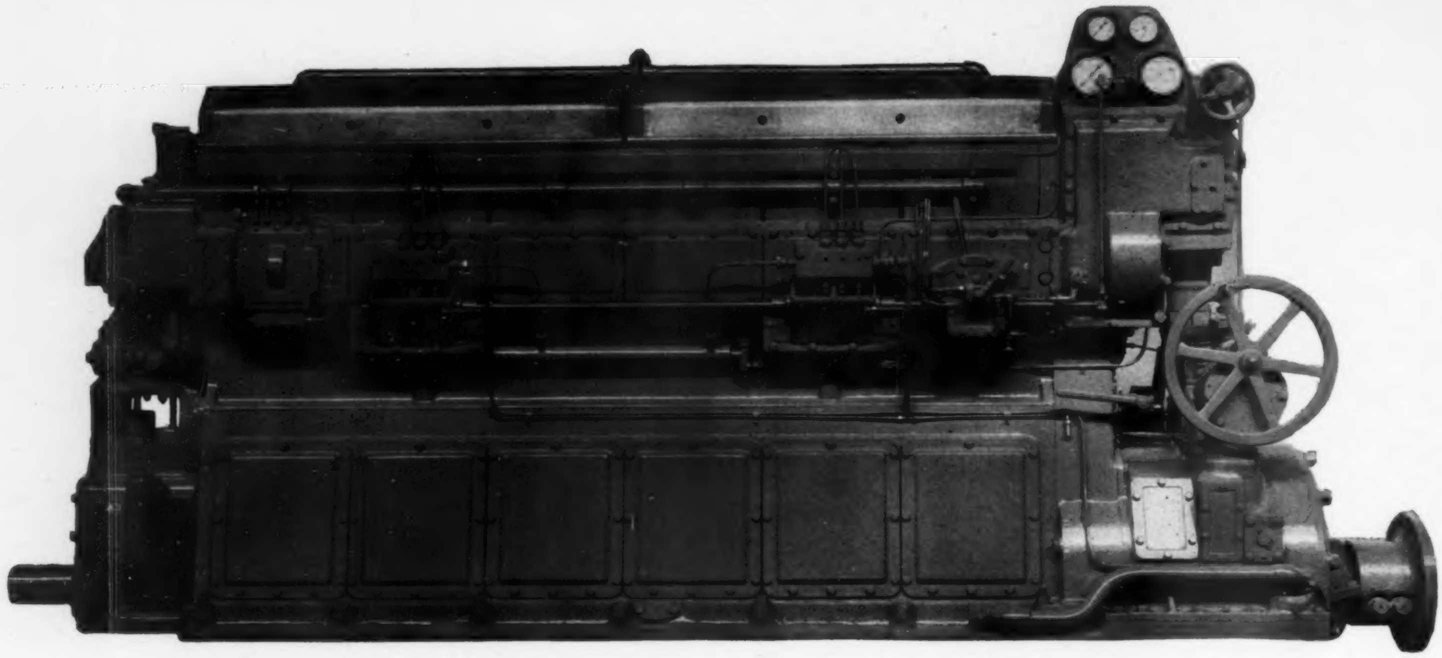
THE Gloucester fishing schooner, *Oretha F. Spinney,* of 134 gross tons, was built in 1920 at Essex, Massachusetts, to the order of Captain Lemuel Spinney. Measuring 107 feet, 2 inches on the waterline with a 24 foot beam and a 13 foot draft, she is a splendid example of that famous fleet which ply the Grand Banks. Captain Spinney sailed her himself as master for a number of years and engaged mainly in halibut fishing. Upon his retirement from the sea, Captain Carl Olsen purchased her and soon won for himself the distinction of being Gloucester's most successful halibut fisherman.

No Diesels are necessary with a breeze like this but, when the breeze dies, a Diesel brings you home just the same.

Both of these owners always kept the vessel in the finest condition, but in 1920 it became necessary to increase her auxiliary power to keep pace with the terrifically keen competition encountered. Captain Olsen selected a Cooper-Bessemer six cylinder, 180 hp., direct reversible Diesel and an 8 hp. Lister generating set. With this power conversion, the *Oretha F. Spinney* was an acknowledged leader in her class.

High adventure was in the offing, however, and descended swiftly when the Metro-Goldwyn-Mayer Studios decided to film Kipling's famous yarn of the sea, "Captains Courageous." M-G-M found itself with a man's sized job in this respect because another great sea story, "Mutiny on the Bounty," was already in production and to equal or top it was no easy task. Progress being the inevitable law, however, Louis D. Lighton, producer, set about to create a film which would be the ultimate in authenticity, in magnificent seascapes and in stirring action. How well he has succeeded is known to those of our readers who have had an opportunity to witness the result.

A camera crew, headed by Marine Director James Havens, journeyed to Gloucester and purchased the prize boat of the Newfoundland fishing fleet, the *Oretha F. Spinney*. At the wheel was Captain Hershey, old-time New England skipper, who had sailed the *Bounty* to Tahiti and back, and with him was the *Spinney's* original crew, Gloucestermen and all. Five months were spent with the fleet filming action shots under every possible atmospheric condition. They cruised off Newfoundland, Nova Scotia, thence to the West Indies, Cuba Keys, through the Panama Canal and up the coast to Los Angeles harbor.

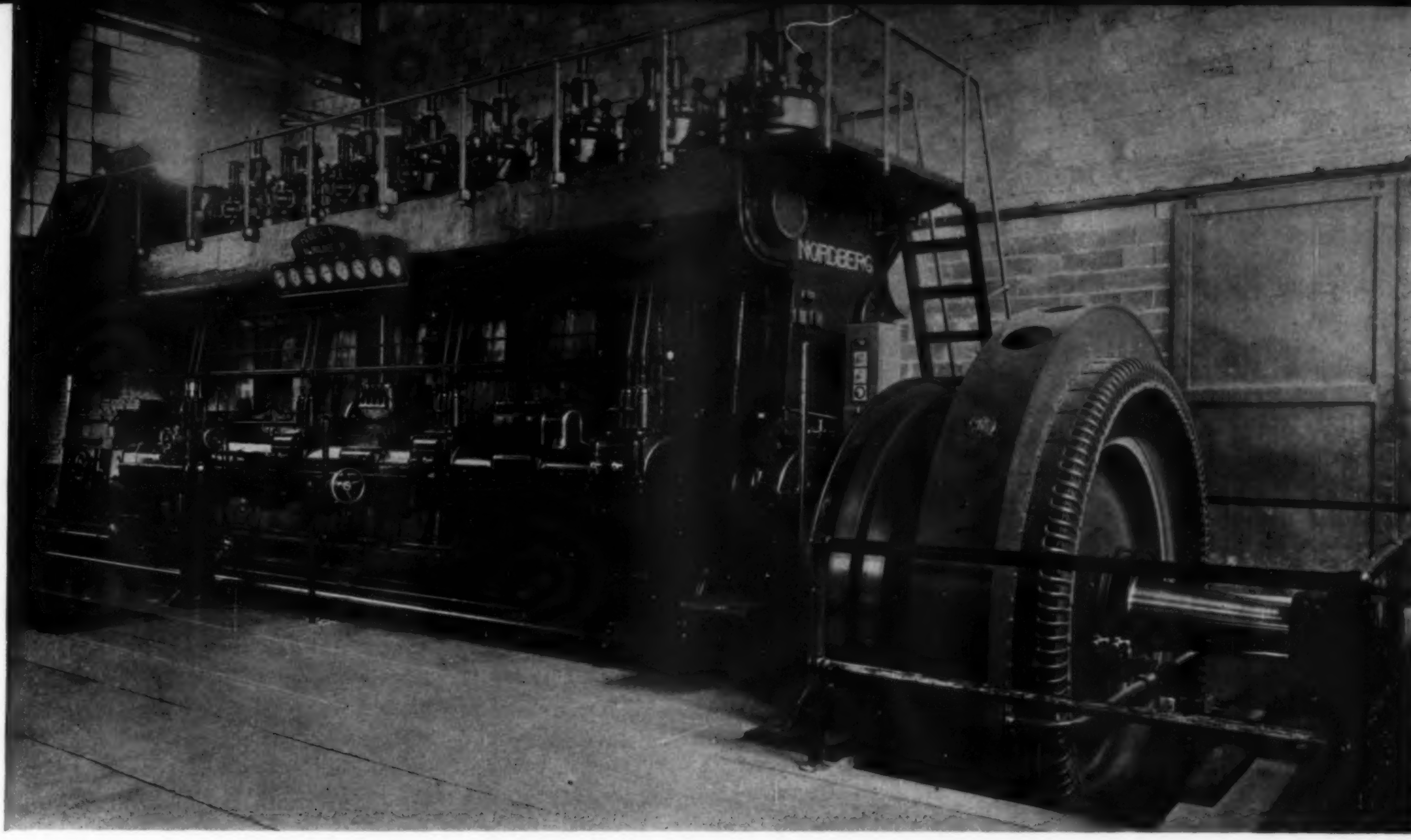


This Model FP-6 Cooper-Bessemer marine Diesel played an invisible but, nevertheless, stellar role in the recent screen version of Kipling's "Captains Courageous."

The *Spinney* was then rechristened *We're Here* to correspond with Kipling's story and took aboard the cast headed by Lionel Barrymore, Spencer Tracy and Freddie Bartholomew.

For the climactic race sequence between the *We're Here* and her rival, the *Jennie Cushman,* in which the latter sails her jib and foresail into rags and the former smashes her mainmast, Director Havens headed deliberately for dirty weather. He got it in the form of the worst storm the Pacific had known in twenty years. At one point the *We're Here* heeled over completely on her side and such a remarkable "shot" was obtained that a special sequence was written into the script to accommodate it.

Despite the fact that the story concerns a sailing vessel, there were many times when both crew and cast were glad of the assurance that a dependable Diesel engine was below decks and thoroughly capable of weathering any blow that the ship herself could stand. How much Diesel fuel economy meant when compared with the fabulous sums spent by the studio in making the picture is problematical, but dependability under all conditions was vital and, of course, unfailing.



The dual fuel burning Nordberg Diesel installed at the Lubbock plant.

A NEW DUAL FUEL BURNING DIESEL ENGINE

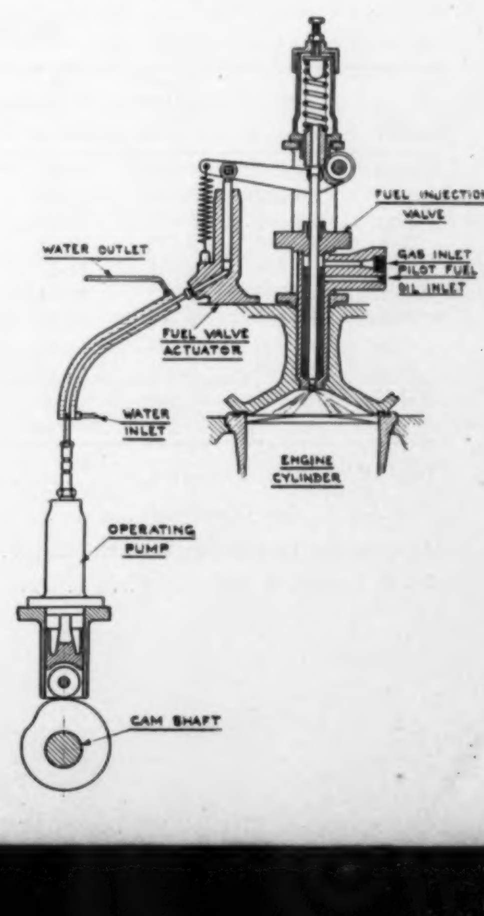
By JOHN W. ANDERSON

DIESEL engines have universally come to be associated with the use of liquid petroleum non-volatile fuels. Numerous attempts to use other fuels have never become widely used commercially; in fact many of the attempts have never gotten beyond the experimental stage. Similarly, the use of natural gas as a fuel is associated with low compression engines using spark ignition and working on the explosive or Otto cycle. So when an engine is developed that uses natural gas as fuel, works on the Diesel cycle, and does it commercially, it is something novel – it is news.

Many engines are made to be convertible for the use of either natural gas or liquid fuel; that is to say, convertible from a gas engine to a Diesel engine. But in all such cases, the changeover requires the substitution of such major parts as the cylinder heads or pistons (and sometimes the cylinders are changed) to say nothing of the different parts needed to handle the difference in fuels. In contrast, this Nordberg engine makes no changes in the major parts of the engine and very few other details need attention, but it does involve the use of the air injection type of Diesel.

Although this engine is called a dual fuel burning Diesel engine, it is essentially a natural gas burning Diesel engine. A small amount of Diesel fuel is also used and injected at every working stroke, but this is a "pilot charge" employed for smoother combustion and amounts to only a small percentage of the total fuel.

The method of operation of the injection system is well shown in the accompanying diagram. The engine itself is of the two-cycle, air injection, Diesel type, with the piston scavenging pump and the three-stage air compressor at the end of the engine opposite the flywheel. The general view of the engine shows the eight working cylinders with the scavening pump and compressor beyond, and also the camshaft running along the front of the engine at a convenient height above the floor level. As a Diesel engine this shaft is used to drive the fuel pumps and operate the spray valves in the cylinder heads by means of the tension rods extending up to them.

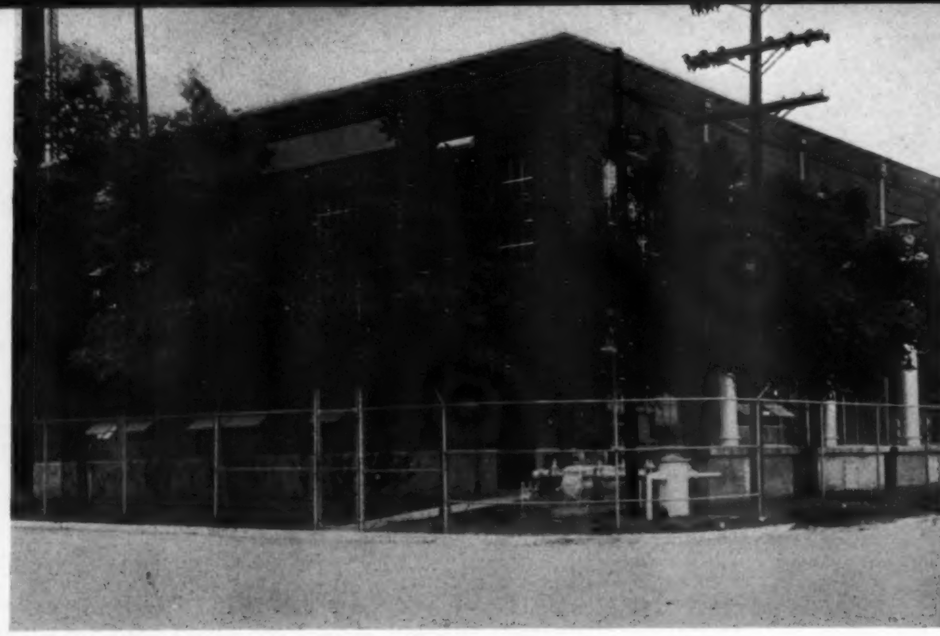


As a gas engine, the camshaft still drives the fuel pumps but they are no longer fuel pumps, rather they are hydraulic pumps for operating the spray valves. This method substitutes the direct governor control of the fuel pumps used on the Diesel for the control of the spray valves on the gas engine. In other words, the normal way of controlling the Diesel is to vary the quantity of fuel fed to the spray valves, accomplished by the governor control of the fuel pumps. But in the gas engine, the control of the fuel is by varying the time the spray valve is open, and this is done hydraulically.

The natural gas fuel is compressed in the engine compressor to about 1,100 lb. per sq. in., and enough of it is handled to supply the load requirements and maintain a nearly constant pressure at the spray valves in the cylinder heads. This compressed gas is supplied to the valves through the regular air injection piping so that no changes are needed for these parts.

But the mechanical operating mechanism for the spray valves is removed, and substituted for it are the fuel valve actuators and levers for lifting the spray valve, plus the high pressure tubings between the former fuel pumps and the fuel valve actuators. In addition there are fuel pumps added for supplying the pilot fuel, one pump for each cylinder. However, no quantity control over these pumps is needed since the same amount of pilot fuel is used regardless of engine load.

Lubricating oil is used in the piping between the operating pumps (the former fuel pumps) and the fuel valve actuators, and the tubing is water jacketed so as to maintain as even a temperature as possible in the operating



Exterior of the Lubbock municipal Diesel plant.

fluid. The action of these operating pumps is to deliver into the tubing a certain quantity of fluid, that builds up a pressure in the valve actuator and lifts the spray valve. When the operating pump releases the pressure, the spray valve is promptly closed by the springs. It is obvious that the greater the quantity of fluid delivered into the tubing, the higher the spray valve lift and the longer it remains open; thus the greater the quantity of gas fuel injected into the working cylinder. But this action of the operating pump is precisely the behavior of the same pump acting as the fuel pump on the normal Diesel engine under the control of the same governor.

The action of the pilot fuel oil is as a combustion stabilizer. During the development of this method, the experiments showed the necessity for it in order to get good mixing of the fuel and air in the combustion chamber and a smooth combustion. Patents have been granted the Nordberg company for the use of this pilot fuel and the burning of the natural gas fuel on the Diesel cycle.

The results of this method are interesting and the chart shows the performance under test of the first of these engines as installed at Lubbock, Texas. It should be remembered that Lubbock is at 3,200 feet elevation. Rated at 1,500 hp. at full load, the curves show the performance from one quarter load upward. The decreasing percentage of total heat contributed by the pilot fuel and the flatness of the fuel curves between half and full load are obvious.

The performance of this engine in service is no less interesting. The nine months record is given in the tabulation of operating figures. During this period, the engine was operated on base load service and the load factor over the entire period was about 75 per cent. The

NINE MONTHS OPERATING RECORD

Date 1936-37	K.W. Hours Generated	Gas Used 1000 Cu. Ft.	Gas Cu. Ft. Per K.W. Hr.	Cost of Fuel			Fuel Cost Per K.W. Hr.	Gals. Lub. Oil Used	Engine H.P. Hrs. Per Gallon	No. of Hrs. Run	No. Hrs. In Month	% Hrs. On Line
				Gas	Pilot Oil	Total						
Sept.	535,700	5,813	10.88	$831.50	$133.36	$964.86	$.00180	216	4,920	708	720	98.25
Oct.	553,600	6,101	11.02	844.54	139.68	984.22	.00178	192	5,780	742	744	99.75
Nov	528,100	5,831	11.03	803.50	135.24	938.74	.00178	186	5,790	718	720	99.75
Dec.	560,800	6,277	11.20	816.01	139.20	955.21	.00171	193	5,740	739	744	99.50
Jan.	535,700	5,912	11.03	768.56	134.10	902.66	.00169	186	5,750	713	744	96.0
Feb.	503,200	5,383	10.70	699.79	125.45	825.24	.00164	179	5,580	666	672	99.5
March	560,600	6,122	10.92	795.86	139.20	935.06	.00167	211	5,250	739	744	99.5
April	547,800	6,175	11.38	802.75	134.80	937.55	.00172	198	5,420	715	720	99.5
May	560,900	6,321	11.29	821.73	136.00	957.73	.00171	212	5,120	722	744	97.0
TOTAL	4,886,400	53,935	11.05 average	$7,184.24	$1,217.03	$8,401.27	$.00172 average	1,773	5,483 average	6,462	6,552	98.6 average

Total K.W Hrs. Generated 4,886,400

Total Cu. Ft. Gas Consumed 53,935,000

Average Cu. Ft. Gas per K.W. Hr. 11.05

B.T.U. Content of Gas .... 975 per Cu. Ft.

B.T.U. Content of Pilot Oil .... 19,200 per Pound.

Cost of Gas .... 13 to 14 Cents per 1000 Cu. Ft.

Cost of pilot Oil .... 4 Cents per Gallon.

Total B.T.U's. per K.W. Hr. Generated 11,670

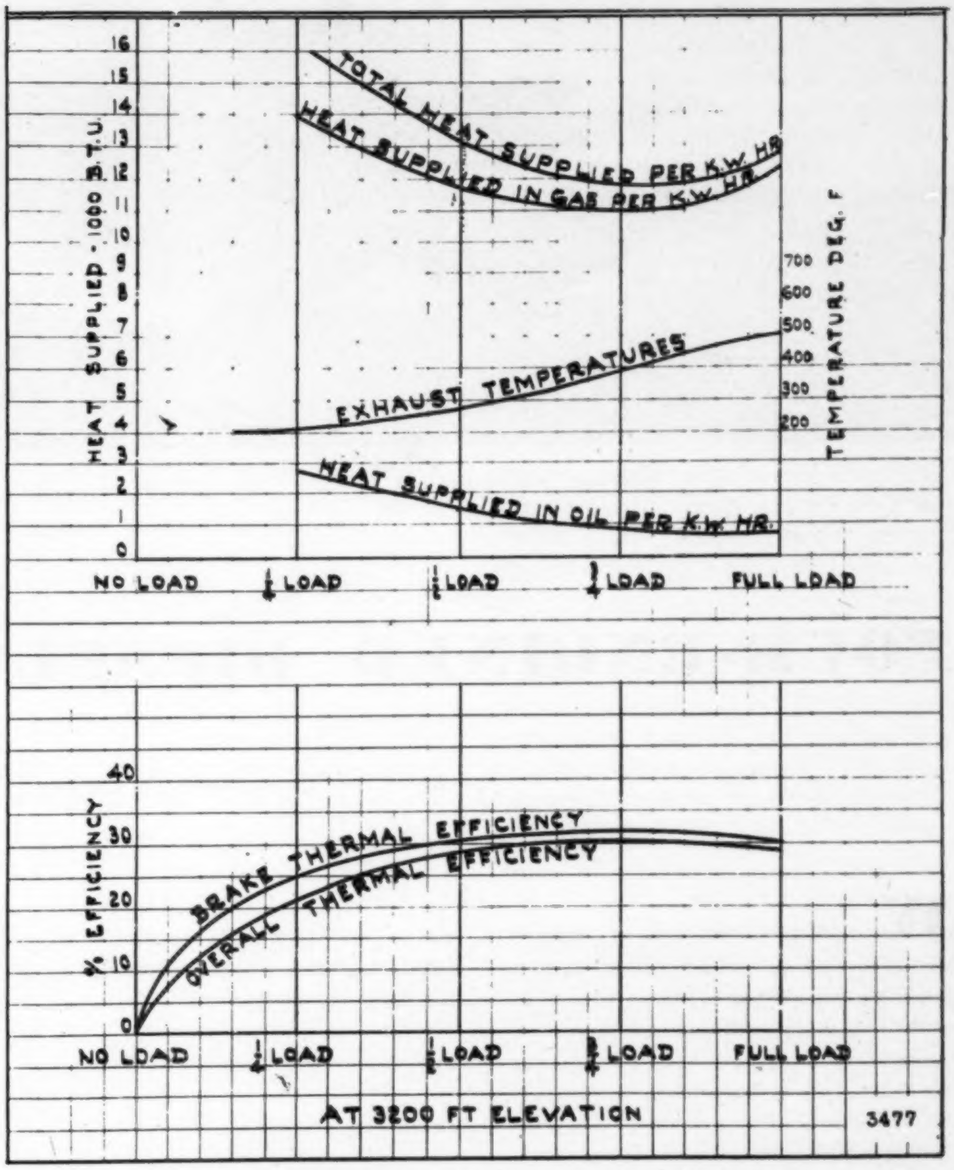
variations in station load were taken by the Diesel engines in the station using regular Diesel fuel. As the figures show, the gas engine ran almost all of the time. In none of the months was this engine shut down more than a total of a few hours, and the average operating time over the entire period was 98.5 per cent of the total hours in that period. This reliability record speaks for itself.

The showing made by these figures brings out the reasons for adopting this combination – the use of natural gas fuel in a Diesel engine. Lubbock has had a municipally owned Diesel power plant for many years. As the city has grown and the load has grown, it has been necessary to install larger and larger engines. Even before this new gas-Diesel engine was installed, there was a 1,250 hp. and a 1,500 hp. engine, both of them two-cycle air injection crosshead type Nordberg Diesels. This last engine is similar to the 1,500 hp. Diesel already there.

But natural gas at low rates, 13 and 14 cents per 1,000 cubic feet in the quantities used, became available and a means was sought to gain the advantage of this and lower the cost of generating power. As shown by the tabulation, the cost of fuel in the new gas-Diesel engine has been proven to be 1.72 mills per kwh. While the station records show that the Diesel engines using fuel costing 3.1 cents per gallon gave a fuel cost of 3.2 mills per kwh. This saving of 1.5 mills per kwh. amounts to 46.2 per cent on a percentage basis, but it is an important reduction in mills cost and in overall cost of power.

Another item shown by the operating record tabulation is the economical performance on lubricating oil. This of course comes from the mechanical construction of the engine and has nothing directly to do with the use of gas as fuel. The crosshead type of construction brings a separation of the cylinders from the running gear in the crankcase and a control over lubricating oil consumption, with beneficial results. The table shows a consistent performance over the entire period recorded.

This brings out another point in connection with operating reliability and cost. The heat and fuel consumption figures, the efficiency percentages, the exhaust temperatures, all show a normal performance as for the same type of Diesel engine. There is no indication of anything abnormal or especially different from the Diesel. This confirms the normalcy of the lubricating oil consumption figures and indicates that other items of operating cost should be the same as for the same engine as a Diesel. Costs for such items as cooling water, supplies, and the important one of repairs should be the same. There is nothing about the gas operating mechanism that should give any operating difficulties, any increased cost of operation, nor require any added attention from the operating crew.



Operating characteristics of the Nordberg Diesel at Lubbock, Texas.

As far as operating behavior is concerned, these engines are as responsive as any Diesel engine using liquid fuel. The reason for using this engine on the base load at Lubbock is its operating economy. It was naturally desired to take full advantage of this.

The field for the use of engines of this type is where there is an abundance of natural gas available at low cost, especially as compared with the cost of suitable liquid Diesel fuel. There is the additional advantage, however, that should there be an interruption to the supply of natural gas, or should the price differentials between natural gas and fuel oil change, the engine can be readily and rather quickly converted to the normal type of Diesel engine. It is a versatile power unit, capable of using a choice of fuels; the choice depending upon the relative costs. And these costs can be figured confidently beforehand, because the unit costs and consumption of fuel are known and the other cost items are independent of the fuel used.

The Nordberg company is prepared to furnish other sizes of this same type within the range of 750 to 3,000 hp. per unit; but as gas engines, there is a reduction of about 10 per cent in the power developed.

The "Nordmeer," one of Deutsche Lufthansa's new four-engined seaplanes, landing after a trial flight.

FOUR-ENGINED DIESEL SEAPLANES

By PAUL H. WILKINSON

WITH four nations planning their air services between America and Europe, air lanes across the Atlantic are beginning to resound to the beat of powerful engines as huge four-engined planes ply back and forth, charting the routes soon to be followed by passenger and mail planes. Pan American and Imperial Airways already have commenced their survey flights this year, and Air France will soon begin its trial flights by way of the Azores. Deutsche Lufthansa, following its four round trip flights last year, is scheduled to make eight round trips this year, with the possibility that mail may be carried on some of them.

As the first three airlines referred to use gasoline engines, while Deutsche Lufthansa uses that ultra-modern power plant, the Diesel, there will be an excellent opportunity for the airline companies to compare notes as to their operating costs, should they so desire. Carrying mail at 20 cents an ounce, fuel will be a most important item to these airlines if they are to be run at a profit and it is highly probable that the other airlines will soon wish that they too had Diesel-engined planes.

The latest report is that Deutsche Lufthansa's *four-engined Ha 139* seaplanes, the *Nordmeer* and the *Nordwind,* will be here about the third week in August. They will follow the same catapulting procedure from the *Friesenland* stationed at the Azores, and the *Schwabenland* stationed at New York, as did the smaller, twin-engined planes, the *Aeolus* and the *Zephir,* when they completed their flights last year. The proposed Diesel-operated transatlantic route from New York is by way of the Azores, Lisbon, Marseilles, Paris and

Left — Gone against the wind! A Blohm & Voss Ha 139 seaplane leaving its floating base, the M.S. "Schwabenland."

Right — The "Nordmeer" poised on the catapult. Notice the excellent streamlining of the four Junkers "Jumo" 205-C Diesels.

Frankfurt-on-Main to Berlin. The 1,400-mile flight from Lisbon to Berlin could, of course, be flown non-stop in about 8 hours if there was no need to call at the intermediate cities.

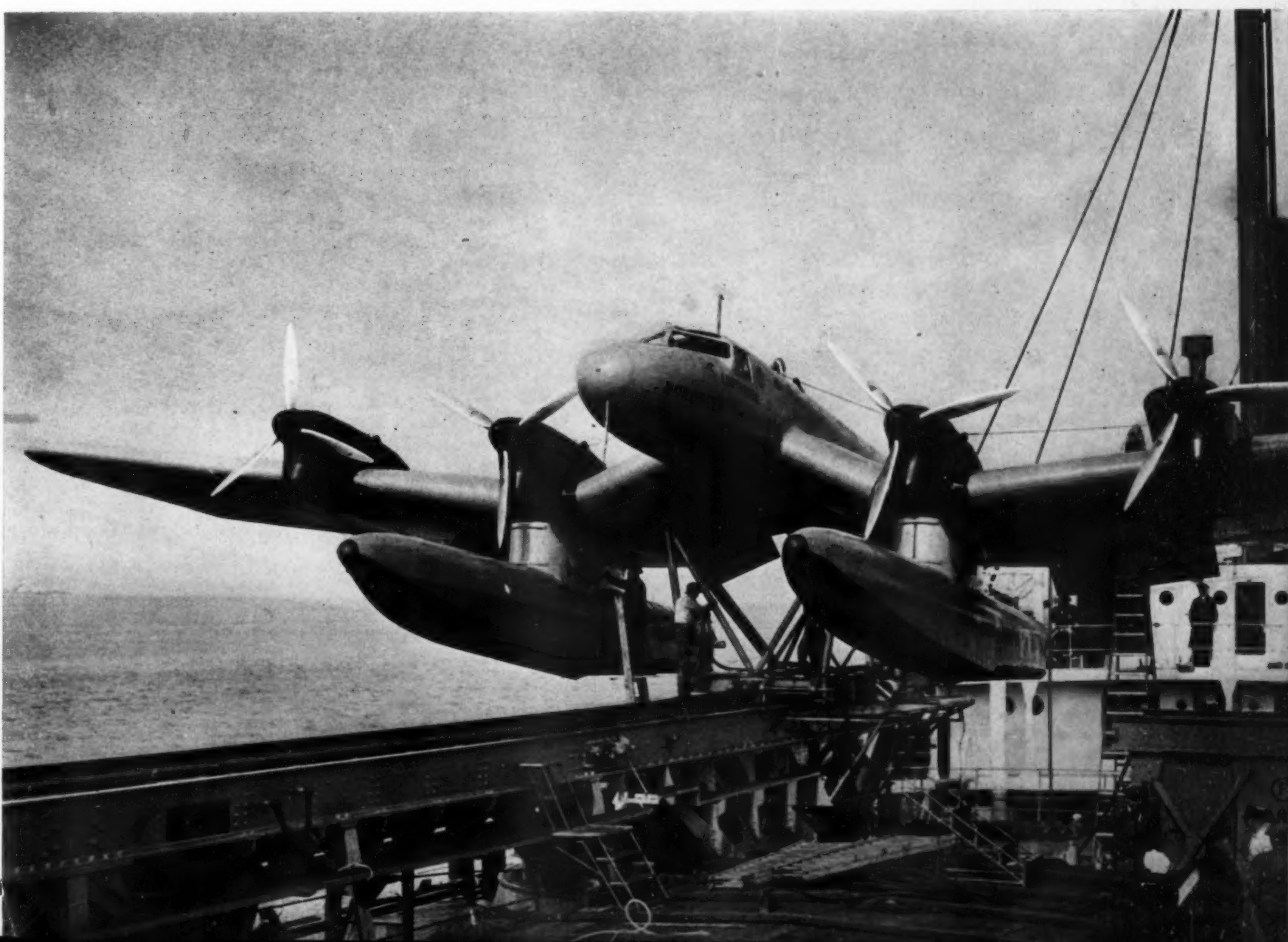
That the fuel situation is one of great importance in other countries, is shown by the recent statement of Signor Enrico Venturini, Director of the famous Ala Littoria airport at Rome: "If heavy-oil engines were adopted on the Italian airlines today, instead of gasoline engines, on the mileage at present flown a saving of 10 million Lira ($526,000) could be realized." This impressive statement was made subsequent to the visit to Italy of two Junkers *Ju 86* planes equipped with Junkers *Jumo 205-C* Diesels, one of these planes being the *Lawrence Hargrave* on its way to Australia, the other the *Kismet* referred to in last month's issue of DIESEL PROGRESS.

Still another interesting angle of the aircraft fuel situation recently was disclosed. It seems that after winning the Oases Circuit Competition in Egypt, Capt. Speck von Sternburg flew the *Kismet,* by way of Bagdad and Teheran, to Kabul in Afghanistan. There a most instructive incident relative to fuel availability occurred, for although there was no regular Diesel fuel available, *the Diesel-engined plane was tanked up with kerosene and completed the next stage of its flight, 930 miles non-stop to Jask on the Persian Gulf, without the slightest difficulty.* The return trip of the 10,800-mile flight was made by way of Bagdad, Damascus, Rhodes, Athens, Sophia, Budapest and Vienna to Berlin.

Lack of fuel safety and poor fuel economy, however, recently were demonstrated by the tragic loss of Amelia Earhart and her navigator, Frederick J. Noonan, in the South Seas. Twice the so-called "flying laboratory" caught fire, which should have been sufficient warning against the dangerous fuel being used. The first blaze occurred at Luke Field, Honolulu, on March 20, when the heavily loaded Lockheed, *Electra* swerved and crashed during its take-off and the port engine caught fire.

According to the account in the *New York Times:* "Miss Earhart's lightening-like maneuver of the throttles and ignition switches apparently prevented an explosion and a fire which would have trapped her and her navigator in an inferno. Even the ground about the plane was drenched in gasoline."

The second blaze occurred at Tucson, Arizona, on May 21, when Miss Earhart landed while on a test flight with her rebuilt plane. Once again, the port engine burst into flames, due to overheating it was said, and when portable fire extinguishers proved ineffective, Miss Earhart jumped back in the plane and extinguished the flames by means of the carbon



dioxide equipment built into the engine nacelle.

Both these fires were very dangerous and should have been sufficient warning — but no, such blind confidence is placed in gasoline that even these incidents were regarded as of little consequence!

After completing half of her trip around the World, on July 2, Miss Earhart and her navigator then set out to fly from New Guinea to Howland Island, a tiny speck in the tropical Pacific 2,570 miles away. Why they never arrived at their destination, and what happened to them, is still a matter of conjecture. Whether radio interference caused them to lose their way, or fire again broke out, or their fuel supply ran short due to bucking head winds, perhaps will never be known. The real reason for their loss, however, would be far more valuable to aeronautics than any data which could be obtained from the elaborate instruments installed on this $80,000 plane. It would supply another definite answer to the problem of long range aerial transportation, and would indicate only too clearly, the outstanding advantages of the Diesel for this type of flight.

As to the cost of this flight to the nation, it has been estimated that the 16-day search for the plane and its occupants cost approximately $4,000,000. Included among the searching parties were the U. S. Coast Guard Cutter *Itasca*, the U. S. Mine Sweeper *Swan*, the U. S. Battleship *Colorado* which brought its three observation planes to the scene from Honolulu, 1,500 miles away, and the British freighter *Moorby* which happened to be in the vicinity. Finally the Navy, under orders to send more help, dispatched the huge airplane carrier *Lexington* with its 60 planes, and the destroyers *Cushing*, *Drayton* and *Lampson* from San Diego to aid in the search.

Such was the effort made by our government to find a plane and its two occupants lost in the Southern Seas. It was a magnificent gesture, with fully 3,400 men and 220 officers engaged in a hunt in intense tropical heat. In the future, however, it is to be hoped that no more flights of this nature will be permitted, for we can neither afford to lose the lives of our fliers on these dangerous ventures, nor spend vast sums of the taxpayers' money to try and rescue them when they are lost.

Our government certainly is to be commended for its prompt and speedy action in this emergency, and the Navy personnel risking their lives in the hunt likewise are worthy of all praise. But one cannot help wondering, if $4,000,000 can be so readily spent on such a search for a needle in a haystack, why a like sum of money cannot also be made available for serious research work to eliminate some of the possible causes of these disasters. Obviously such a sum of money, intelligently allocated for Diesel aircraft engine research and *production*, would go far toward eliminating electrical interference, fire hazard and high and costly fuel consumption which are ever present on the flights of American aircraft today.

Playing with fire! Just as long as gasoline is used to provide the propulsive power for aircraft, shall we be faced with the fire problem. More than $1,000,000 worth of aircraft were lost last year in this way — to say nothing of many valuable lives — and still our government cannot make up its mind as to what policy to pursue. Meanwhile, the holocaust of gasoline-engined planes continues, not only in the United States but also in other countries which have been slow to adopt the Diesel for commercial and military purposes.

The "Schwabenland" catapults a Ha 139 seaplane for a trial flight over the Kiel Canal.

DIESEL ENGINES

By JOHN W. ANDERSON

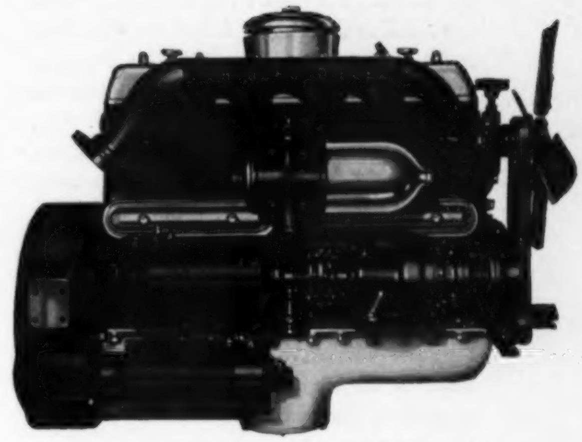
No. 6. HERCULES

DESIGNED to be adaptable to a wide variety of power applications, at present all Hercules Diesels are of the six cylinder, four cycle type. Their speed, power and torque range is clearly shown on the power chart. The wide speed range coupled with general performance characteristics and design of Hercules Diesel engines makes them particularly suitable for many different types of applications and opens new possibilities for the use of Diesel engines which heretofore have been excluded because of the limitations of speed and weight in the engines previously available. The general basic design of all of the engines in the line is the same, but the attachments to the engine are varied to suit the applications to commercial vehicle, industrial, rail car, agricultural, oil field and marine use.

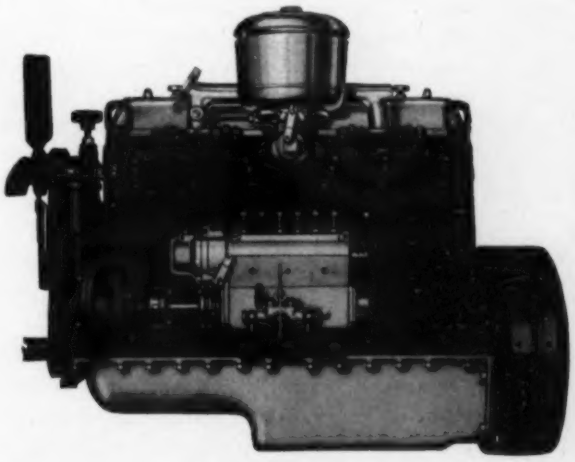
Of the four engines described here, the smallest one has cylinders 3½" by 4½", and the largest one 5" by 6", the displacement ranging from 260 cu. in. to 707 cu. in. Before taking up the mechanical design details let us give attention to the combustion system. The location and action in the combustion chamber is one of the notable features of these engines.

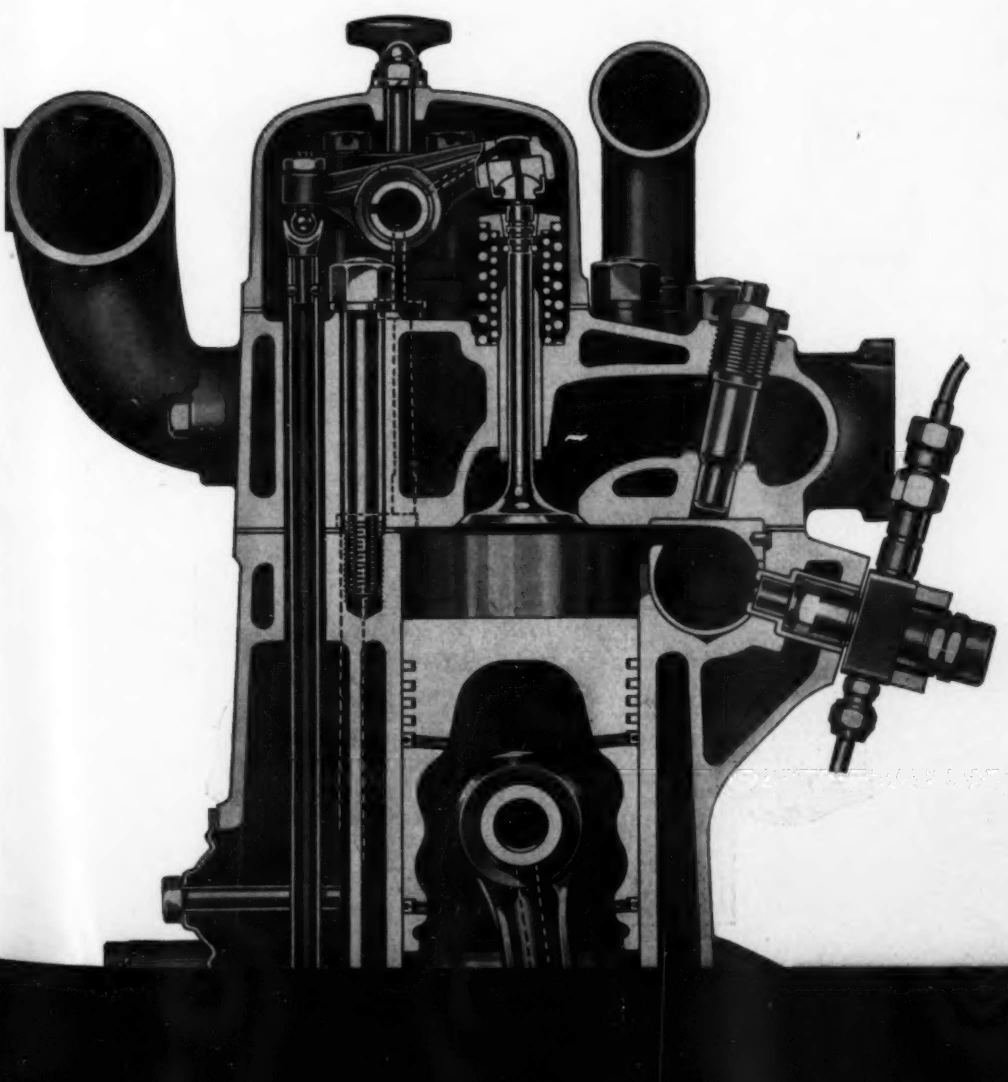
The sectional illustration shows the location of the spherically shaped combustion chamber relative to the cylinder. When the piston is at the top of its stroke it is as close to the cylinder head as mechanical requirements will permit, so that all of the air in the cylinder, or at least nearly all of the air, is forced over into the combustion chamber.

The combustion chamber is placed as close as is practical to the cylinder bore thus reducing the length of the throat between the cylinder and the chamber to a minimum. This combustion chamber is in two pieces. The lower part is of alloy steel and contains the spherically shaped cavity. Note especially the lip just below the throat opening from the cylinder space, which turns the whirling air inside of the chamber. This lower chamber piece fits into a machined cavity in the cylinder block.



Hercules Diesel Model DJX, showing both exhaust side (above) and fuel pump side (below).





The upper part of the chamber is of carbon steel, and cylinder head is machined to take a portion of this part. The head is located by the upper combustion chamber pieces but is not supported by them.

Of course, there is an opening in the lower chamber piece for the fuel injection nozzle, which is shown in the picture at the right. The nozzle is located so that the fuel is injected slightly above the horizontal and towards the opposite side of the chamber just below the throat opening from the cylinder. In all of the engines an opening can be provided in the top combustion chamber section for the electric glow plug used in starting under some conditions. The cooling of the com-

bustion chambers is arranged to maintain proper temperature for complete combustion.

The action of this combustion chamber is readily seen from the diagram showing the velocity of the air through the throat passage between the cylinder space and the chamber. This diagram also shows why the combustion chamber is located as it is. The figures in the diagram are for an engine speed of 2000 rpm. and, of course, they vary directly with the speed. As the piston comes up on the compression stroke, the air is pushed over into the combustion chamber at increasing speed. This is the result of the piston velocity. The higher the piston position, the greater the relative change in the velocity of the air through the throat. The curve of piston velocity peaks at about 25 crank angle degrees before top center, as shown by the dotted line curve.

Now refer to the sketch at the upper left hand corner of the diagram and note the influence of the port closure by the piston motion. The top of the piston begins to close off the throat port at 37½ crank angle degrees before top center, and the throat area becomes progressively less until the piston reaches top center. The great increase in velocity which this action gives is clearly shown by the solid line, which peaks about 8 or 9 degrees before top center. And the maximum velocity is almost four times what it would be without this closing of the throat port by the piston motion.

The net result of all this is that the rotary motion of the air in the combustion chamber is started early in the compression stroke and gradually increases in intensity until it reaches its greatest velocity just before top center. As shown, fuel injection begins about 18 degrees before top center. Under full load conditions, this injection is taking place just when the air in the chamber is in its most turbulent condition. It ensures a thorough mixing of the fuel and the air in the chamber. Combustion proceeds vigorously, and indicator cards taken during tests show that the combustion is complete by the time the crank is approximately 20 degrees past top center.

In this connection it might be said that since combustion is completed so early in the expansion cycle that the engine is potentially capable of a large number of expansion ratios.

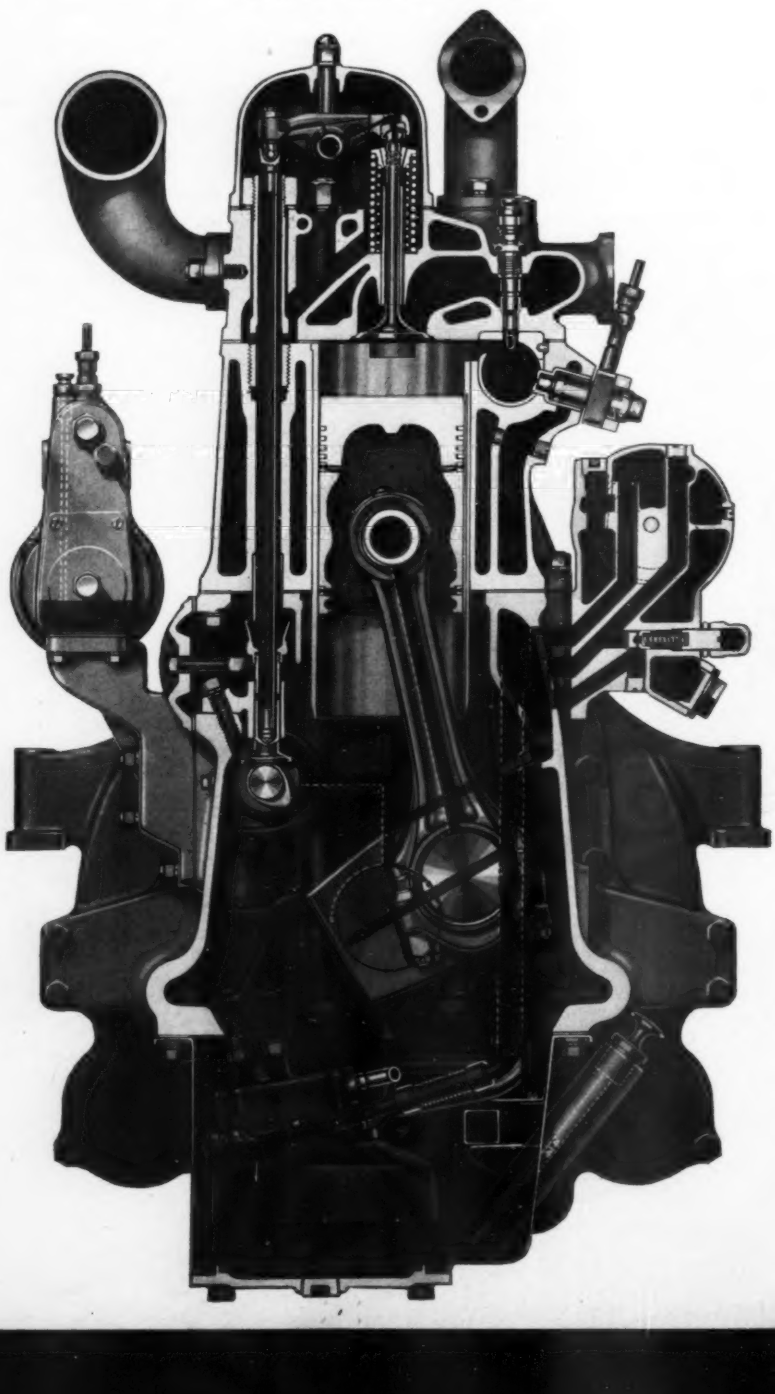
Since the intensity of the turbulence varies with the engine speed, the intensity of the combustion also varies in somewhat the same ratio. To some degree, the process is self regulating. But it is not entirely so. On the larger engines where the service calls for a very wide speed range, the fuel injection pump is fitted with a special coupling on the drive shaft by means of which the relative angular position of the injection pump shaft to the crankshaft can be changed. This change of timing is under the control of the operator. Although the intensity of the turbulence varies with the engine speed, the number of times the air in the combustion chamber rotates for each combustion period is much the same, because the rotation of the air is due to its displacement from the cylinder space.

These engines have quite a flat fuel consumption curve, which turns up somewhat at the lowest and the highest speeds. Of course, the fuel consumption also varies with the size of the cylinder. The largest engine has a minimum fuel consumption of 0.38 lb. per hp. hr., and the smallest engine has a minimum consumption of about 0.44 lb. These figures refer to full torque conditions.

Injection of the fuel is by the Bosch type pump mounted on the side of the engine as can be seen from the pictures. This pump on the larger engines is on the same side as the camshaft although it is on the opposite side on the smaller "DJX" series engines. The fuel injection pump is driven from the camshaft by means of a timing chain. This chain has an adjustable sprocket for maintaining the proper tension on the chain. The injection valves are of the pintle nozzle type. There is a transfer pump for delivering the fuel from the storage tank to the injection pumps and there is a strainer for ensuring clean fuel.

The general and detail construction of the engine is shown by the outside views and by the sections. In the smaller engines, the crankcase and the cylinder block are cast in one

Hercules transverse cross section.

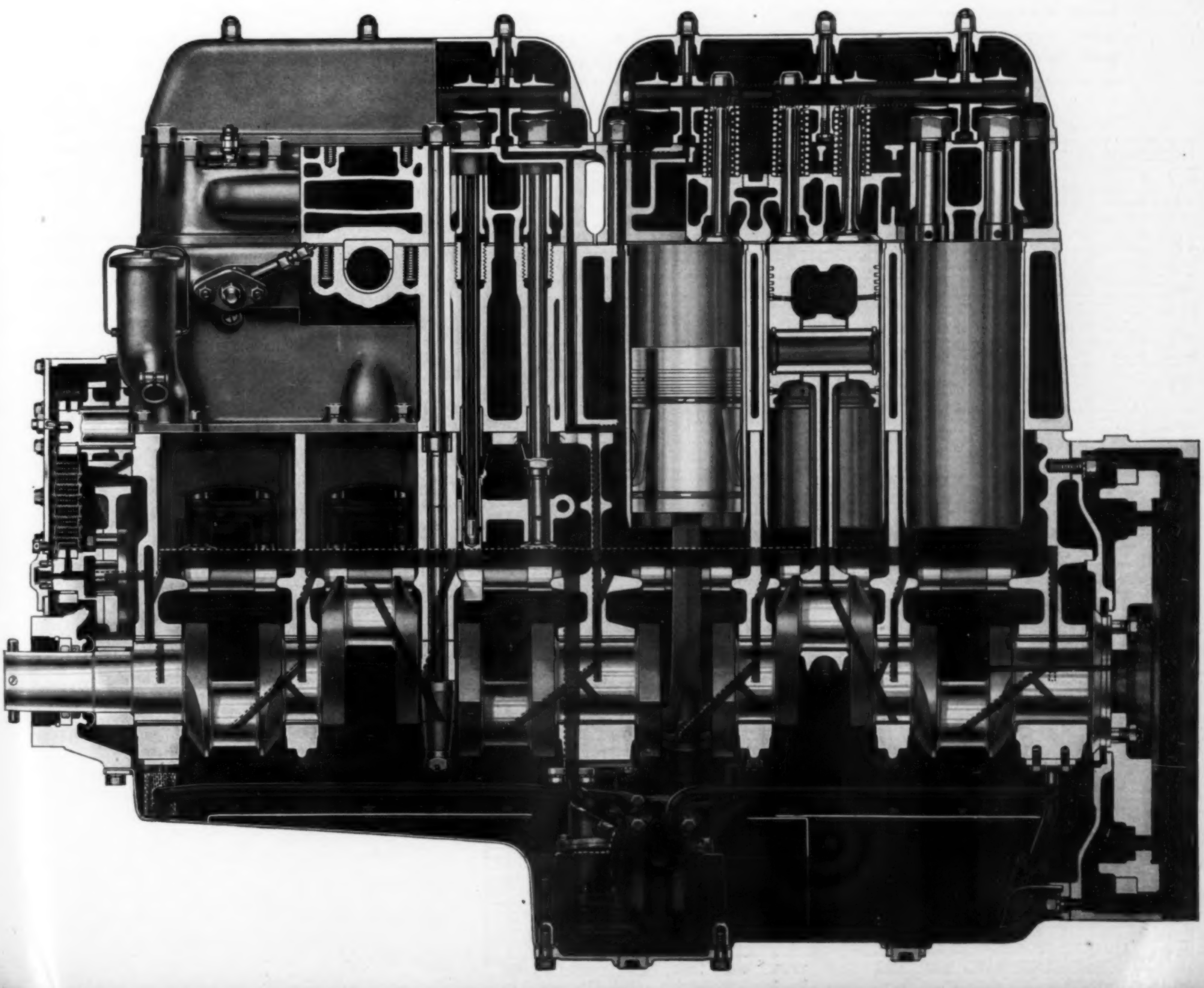


piece of alloy cast iron, but the largest engine has separate castings for the crankcase and for the cylinder block. And in this case, the crankcase is made of aluminum when the weight restrictions demand it. The two castings are securely held together by special through bolts. As shown in the sketch, these alloy steel stud bolts have an eccentric head or center portion which is seated in a corresponding hole or recess in the top of the crankcase. The eccentric portion prevents the studs from turning. These studs extend from the top of the cylinder head to the main bearing caps, and the main bearing end of the studs is larger in diameter than the upper end. This permits the main bearings to be adjusted independently of any adjustment made on the top end. And, of course, these studs absorb directly the gas load reactions between the cylinder heads and the main bearings on the crankshaft. All Hercules Diesels have crankshafts hardened by the Tocco process. The pistons are of aluminum with solid skirts, and with thick heads for carrying off the heat and maintaining a low temperature. Wrist pin is of the full floating type, and the main and crankpin bearings are of the non-adjustable precision type. In order to use as large a crankpin as possible and still get the foot of the connecting rod up through the cylinder bore, the smaller engines have the connecting rod at the crank end split at an angle. A tongue and groove construction is used to take the shearing action from the screws which hold the crankpin bearing cap.

On the larger models, there are two cylinder heads per engine, one for each group of three cylinders. This separates the groups of cylinders, and note how the middle and end main crankshaft bearings are much longer than the intermediate bearings. This gives a very compact construction for the engines. The cylinder heads have only to carry the inlet and exhaust valves. The latter are smaller in diameter than the former, and all of them seat directly in the heads. A flat gasket of soft copper is fitted between the heads and the top of the cylinder block for making the joints tight. Cooling water passes from the block to the jacket space in the heads. Lubricating oil passes from the block to the valve gear on top of the cylinder heads. This gasket not only seals the gas joints for the cylinders but also seals the water and oil joints between the cylinder block and cylinder head.

Of course, the push rods and the valve gear rockers and parts are entirely enclosed as shown, but note also that the push rods and valve gear are shut off in a special compartment separated from the crankcase. This prevents any crankcase gases, some of which may be corrosive, from getting up onto the valve

Longitudinal cross section. Paths of lubricating oil are indicated by color in both views.



gear parts. Lubricating oil draining back to the crankcase from the valve gear passes through traps sealing these openings from the entrance of gases. The camshaft is in the crankcase and it is driven directly from the crankshaft by Helical gears for quietness.

All parts of the engine requiring lubrication are served from the one system. The pan under the crankcase acts as the sump to which all oil drains on the return, and it is shaped to bring the oil to the pump suction even though the engine is inclined within reasonable limits. The gear type pressure pump is located in this sump on the end of the vertical shaft which is driven from the camshaft. Suction is through a strainer, and delivery is through a filter on the side of the engine, to the header which supplies all of the main bearings. The crankshaft and connecting rods are drilled to carry the oil to the cranks and wrist pins. Then there is another branch for carrying the oil to the hollow rocker shafts for the valve gear at the top of the engines. Since only a limited supply of oil is needed for the inlet and exhaust valve stems, the flow of oil to these points is restricted to these parts. In addition the tops of the valve stem guides are sharply beveled so that any surplus oil will be scraped from the valve stems. Other branches in the rockers feed the push rods. All openings in the crankcase for the shafts which extend through are carefully sealed. Each piston has two oil control rings, one just below the compression rings and one on the skirt of the piston.

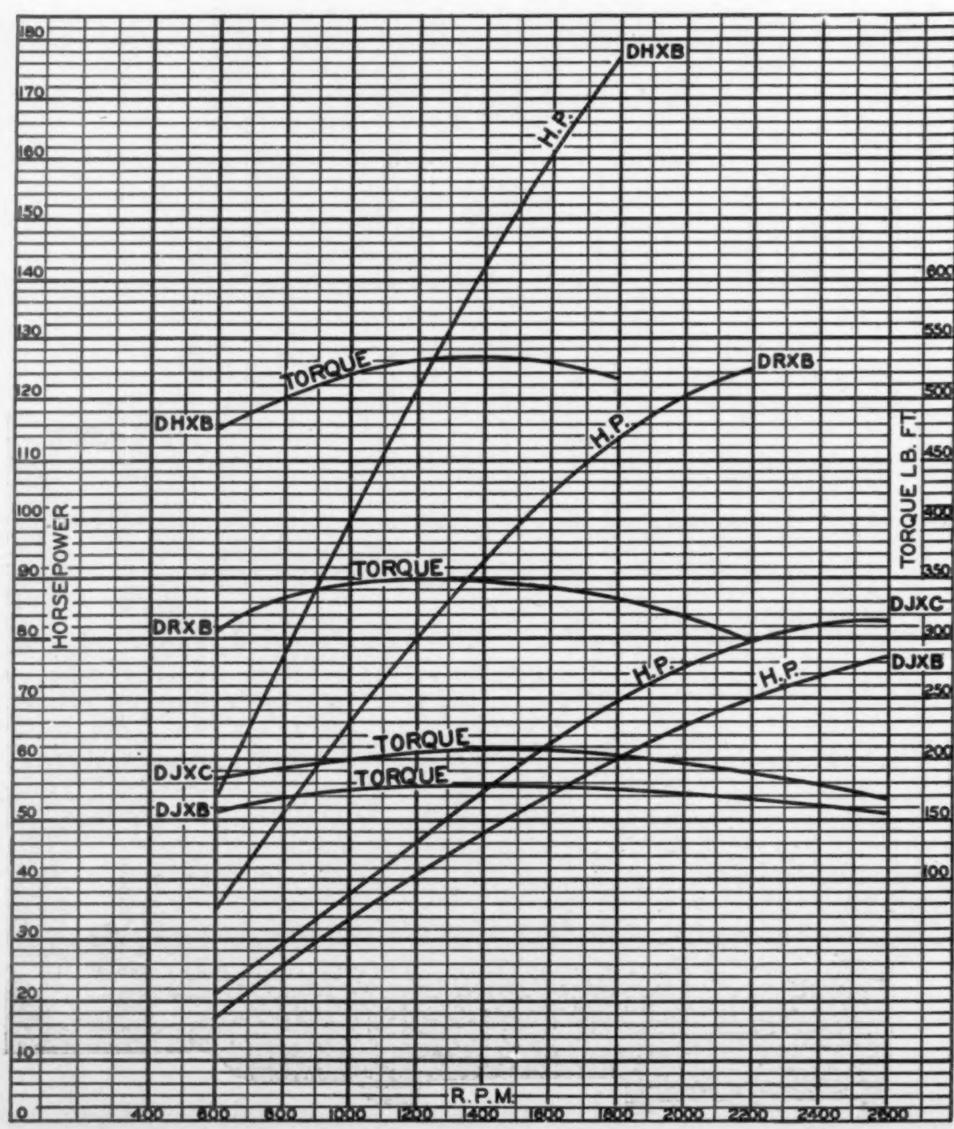
Connected into the lubricating oil system is the Viscometer shown in the illustration. The gauge dial is marked low, normal and high. Thus the idea is to use an oil of such a viscosity that at the service operating temperature, the viscosity is normal. Of course, a good grade of oil must be used, but this instrument shows whether it has the proper body to provide oil films when will take the bearing loads under the operating conditions.

All of these engines have centrifugal cooling water pumps, which deliver through the cylinder jackets to the cylinder heads. In order to make sure that all parts of the engine are thoroughly cooled, there are baffles and passages to control the flow of water. Special care is taken to ensure a vigorous flow in the regions around the combustion chambers and nozzles to cool that portion of the cylinder block adjacent to these parts. A thermostat on the cylinder head outlet controlling the temperature of the discharge is recommended.

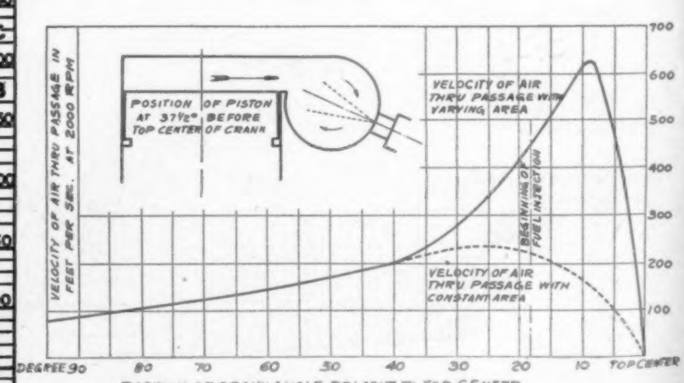
The parts attached to the outside of the engines vary somewhat with the service application. This is especially true of the starting equipment. When electric starting is used, there is the generator driven by the engine, and the motor which drives through the flywheel in the usual manner. But some installations require a gasoline starting engine instead of the electric motor. The type of governor also varies with the service. On the larger engines it is of the centrifugal type and is combined with the fuel injection pump on which it acts to control the speed. On the "DJX" series, the governor is of the vacuum type and the vacuum produced in the venturi of the air intake acts on the fuel injection pump through which the speed is controlled.

All engines, however, have the intake manifold with the air filters on one side of the engine and the uncooled exhaust manifold on the other side. Water cooled exhaust manifolds are available and can be furnished. Then there are the injection pumps on one side, and the cooling water pump and the lubricating oil filter on the other. The position of the electric starting motor or electric generator can be varied with the requirements of the application. When a radiator is used for cooling the jacket water, there is a fan on the end of the engine and driven from it.

And, finally, let is be noted that these engines, except for their height, are interchangeable with gasoline engines of the same make and same piston displacement. The height is greater because overhead valves are used in place of L head construction for the gasoline engines.



The torque and horsepower for speeds between 600 and 2600 rpm. are shown for four models in the large graph. The chart below is an interesting gas velocity diagram plotted against crankshaft position.



COMBUSTION ANALYSIS

By B. J. VON BONGART

COMBUSTION — whether taking place in the open atmosphere or under confinement, i.e., fire-box, engine's cylinder, etc. — has long been regarded as pyrotechny; useful in that the heat generated during the combustion could be applied in various ways and for numerous purposes. In so far as the internal combustion engine is concerned, the expansive force of the heat of the combustion was utilized to operate a piston and its appendages, in other words, to run an engine.

The early technicians made full use of the combustion process, but in the matters of cause and effect they conveniently assumed a *non possumus* attitude. It remained for the chemists to investigate the combustion process, and they found that combustion is no more nor less than oxidation, which, due to the rapidity with which it takes place, generates heat. The chemists asserted that combustion is merely "pyrogenic disintegration," an oxidizing and decomposition process, that these chemical reactions are the *deus ex machina,* and that the visible manifestation, i.e., a flame and its attendant heat, was merely a "side show." Thus the pyrotechnics (flame, heat) are merely the effect of a cause, the accompanying chemical reactions being the cause. That was a hard pill to swallow for the technicians, but the chemists won their point.

Since we are concerned with Diesel engines only, we must confine ourselves to fuel-oil and to the combustion process as actually taking place within such an engine. The fuel-oil used today is essentially a mixture of hydrocarbons of the composition of $C_nH_{2n}+_2$ (or in our mother-tongue saturated hydrocarbons, i.e., paraffinic oil), and C_nH_{2n}, an oil-forming gas called olefine or olefiant gas (from the French, *gaz oléfiant*), also known as ethane or marsh gas. In table 1 are given some of the substances contained in a typical natural crude oil of a paraffinic base.

The pentane, hexane, heptane and octane are the principal constituents of gasoline; hence they are removed from the crude oil, since these highly volatile esters are unsuitable for Diesel fuel-oil. The paraffines of higher boiling-points (nonane upwards) are usually reserved for kerosene; hence they, too, are often removed. The olefines, ethylene and subsequent, are hydrocarbons averaging higher boiling points than paraffines, as table 2 indicates.

Name	Formulae	Boiling Point °C.	Substance
Methane	CH_4	—164	
Ethane	C_2H_6	— 93	
Propane	C_3H_8	— 45	gaseous
Butane	C_4H_{10}	+ 1	
Pentane	C_5H_{12}	+ 38	
Hexane	C_6H_{14}	+ 69	
Heptane	C_7H_{16}	+ 98	
Octane	C_8H_{18}	+124	
Nonane	C_9H_{20}	+150	liquid
Decane	$C_{10}H_{22}$	+173	
Undecane	$C_{11}H_{24}$	+195	
Duodecane	$C_{12}H_{26}$	+214	
Tridecane	$C_{13}H_{28}$	+234	
Tetradecane	$C_{14}H_{30}$	+253	solid
etc.			

Table 1. Constituents of paraffinic crude oil.

Name	Formulae	Boiling Point °C.	Substance
Ethylene	C_2H_4		gaseous
Propylene	C_3H_6		
Butylene	C_4H_8	+ 3	
Pentylene	C_5H_{10}	+ 39	
Hexylene	C_6H_{12}	+ 70	
Heptylene	C_7H_{14}		liquid
Octylene	C_8H_{16}	+125	
Nonylene	C_9H_{18}		
Decatylene	$C_{10}H_{20}$	+160	
Cetene	$C_{16}H_{22}$	+275	
Cerotene	$C_{27}H_{54}$		solid
Melene	$C_{30}H_{60}$		
etc.			

Table 2. Constituents of Olefines.

Aside from the paraffines and olefines, the crude oil contains aromatic hydrocarbons (benzol, etc.) in negligible quantities, and sulphur in small amounts; 0.5 to 2.5 per cent is usual, except for South African crudes, which seem to be free from sulphur. During the combustion process, sulphur is transformed into SO_2, and its presence in minute quantities is harmless, whereas large amounts may form FeS (ferrosulphide), which has been known to attack the fuel nozzles, the valves or ports, and even the exhaust manifold.

Since fuel-oil consists essentially of carbon and hydrogen, the final end-product of the oxidation must be carbonic acid (CO_2) and vapor (H_2O). But that presupposes that the combustion is complete and that the fuel contained no other substances but carbon and hydrogen. The oxygen required for the combustion process is taken from the atmospheric air. The latter consists of 23.2 per cent oxygen and 76.8 per cent nitrogen by weight, not volume. In addition to these two substances, the air we breathe contains varying quantities of metallic and other dusts, inert gases, etc., and all of these substances react in their own manner during the combustion process. If we now analyze an engine's exhaust, we find not only CO_2 and H_2O but very often soot and small quantities of carbonic oxide (CO). The soot expelled with the exhaust is not pure carbon, but a highly molecular hydrocarbon, and its presence indicates that the combustion was incomplete because of poor mixing of the fuel-air charge (lack of turbulence), or to overloading (excessive fuel injection). The presence of CO in the exhaust indicates arrested combustion. On the whole, Diesel engines show less carbonic oxide in the exhaust than carburetted-fuel engines; this is due to the fact that Diesel engines operate with a surplus of oxygen (air) and hence the CO content is diluted with air to such an extent that the magnitude of its presence cannot always be readily ascertained.

It has been assumed that fuel-oil (after ignition) disintegrates into C and H and that these elements then mix with the oxygen contained in the air and eventually form CO_2 and H_2O, according to the formula:

$$CO+\tfrac{1}{2}O_2 = CO_2 \quad\ldots\ldots\ldots\ldots\ldots 1)$$

The very simplicity of such a process precludes its possibility. The combustion advances through a large number of highly complicated chemical reactions, and to this very day we cannot pretend to have a complete knowledge of the entire combustion phenomenon. In so far as No. 1 is concerned, Dixon[1] discovered during experiments in 1884 that perfectly dry carbon and oxygen would not burn, whereas with but a slight addition of vapor, combustion would readily take place. This discovery convinced Dixon that the quantities of CO, O_2 and CO_2 as indicated in formula 1) were correct for the combustion process, but did not indicate the sequence of events as taking place during combustion. Hence he originated the formula:

$$CO+H_2O = CO_2+H_2$$
$$2H_2+O_2 = 2H_2O \quad\ldots\ldots\ldots\ldots\ldots 2)$$

This theorem stood until Wieland[2] asserted that

[1]H. Dixon, Trans. Roy. Soc., London. Vol. 176, p. 617, 1885.
[2]Wieland, Deutsch. Chem. Ges., Vol. 45, p. 679, 1912.

carbon and oxygen (CO) and vapor (H_2O) could not possibly be directly transformed into carbonic acid and hydrogen (CO_2+H_2), but that such chemical reaction would have to proceed through an intermediary, namely, formic acid (HCOOH), and thus Wieland formulated:

$$\begin{aligned}&CO+H_2O = HCOOH\\&HCOOH = CO_2+H_2\\&H_2+\tfrac{1}{2}O_2 = H_2O \quad\ldots\ldots\ldots\ldots\ldots 3)\end{aligned}$$

But even this scheme of the combustion of carbonic oxide (CO) is not correct, since Von Wartenberg and Sieg[3] proved that the combustion of CO would produce as a by-product superoxol (H_2O_2), which in itself is an indispensable intermediary in the combustion of carbonic oxide, and hence they changed Wieland's formula to:

$$\begin{aligned}&CO+H_2O = HCOOH\\&HCOOH+CO_2 = H_2\\&H_2+O_2 = H_2O_2\\&H_2O_2+H_2O = \tfrac{1}{2}O_2 \quad\ldots\ldots\ldots\ldots 4)\end{aligned}$$

Since fuel-oil contains a number of ingredients, such as methane (CH_4) – table 1, and ethylene (C_2H_4) table 2 – and also acetylene (C_2H_2), Bone and Wheeler[4] stated that carbonic oxide (CO) appears again as a combustion product during the chemical reaction involving these three gases. For methane (CH_4), Bone and Wheeler claim

$$CH_4+O_2 = CH_2O+H_2O \quad\ldots\ldots\ldots 5)$$

wherein the formaldehyde (CH_2O) simultaneously oxidizes according to the formula

$$\begin{aligned}&CH_2O+O_2 = CO_2+H_2O \text{ and}\\&2CH_2O+O_2 = 2CO+2H_2O \quad\ldots\ldots\ldots 6)\end{aligned}$$

and eventually into CO_2 and CO.

For ethylene (C_2H_2), Bone and Wheeler formulated

$$C_2H_4+O_2 = 2CO+2H_2 \quad\ldots\ldots\ldots\ldots 7)$$

and for acetylene (C_2H_2)

$$C_2H_2+O_2 = 2CO+H_2 \quad\ldots\ldots\ldots\ldots 8)$$

Since all of these combustion mechanisms lead to the formation of carbonic oxide (CO), it is self-evident that the combustion of methane (CH_4), ethylene (C_2H_4) and acetylene (C_2H_2) must proceed over CO towards the final end-product of carbonic acid (CO_2) and vapor (H_2O). The formulae of Bone and Wheeler, 6, 7 and 8, are essentially correct, but incomplete. According to present day conceptions, the combustion of methane (CH_4) proceeds through no less than five intermediates, to wit:

$$\begin{aligned}&CH_4+O_2 = CH_2O+H_2O\\&CH_2O+O_2 = CO_2+H_2O\\&2CH_2O+O_2 = 2CO+2H_2O\\&CO+H_2O = HCOOH\\&HCOOH = CO_2+H_2\\&H_2+O_2 = H_2O_2\\&H_2O_2 = H_2O+\tfrac{1}{2}O_2 \quad\ldots 9)\end{aligned}$$

We see here that methane (CH_4) by chemical reactions is transformed into formaldehyde (CH_2O), thence into carbonic oxide (CO) and further into formic acid (HCOOH), and subsequently into hydrogen (H_2), and thence into the last intermediate, superoxol (H_2O_2).

The combustion process of ethylene (C_2H_4) and of acetylene (C_2H_2) embraces but four intermediates, and they are substantially identical, as the formulae No. 10 and No. 11 indicate. For ethylene (C_2H_4), the process advances thus:

$$\begin{aligned}&C_2H_4+O_2 = 2CO+2H_2\\&H_2+O_2 = H_2O_2\\&H_2O_2 = H_2O+\tfrac{1}{2}O_2\\&CO+H_2O = HCOOH\\&HCOOH = CO_2+H_2\\&H_2+O_2 = H_2O_2\\&H_2O_2 = H_2O+\tfrac{1}{2}O_2 \quad\ldots\ldots\ldots\ldots 10)\end{aligned}$$

The acetylene (C_2H_2) disintegration progresses during the combustion process as follows:

$$\begin{aligned}&C_2H_2+O_2 = 2CO+H_2\\&H_2+O_2 = H_2O_2\\&H_2O_2 = H_2O+\tfrac{1}{2}O_2\\&CO+H_2O = HCOOH\\&HCOOH = CO_2+H_2\\&H_2+O_2 = H_2O_2\\&H_2O_2 = H_2O+\tfrac{1}{2}O_2 \quad\ldots\ldots\ldots\ldots 11)\end{aligned}$$

Fuel oil consists of a number of substances (tables 1 and 2), yet the chemical transformations taking place during the combustion process are perhaps closely identical. Evans[5] investigated the oxidation phenomena of ethane (C_2H_6), (a gas found in all paraffinic oils), and he discovered that the combustion process of this gas produced, among other substances, formaldehyde (CH_2O) and formic acid (HCOOH) and thus Evans believes that the oxidation process of ethane (C_2H_6) is undoubtedly similar to that of methane (CH_4).

Von Wartenberg[6] in his researches in connection with paraffinic oils – which are mainly used as Diesel engine fuel – found that these oils have a tendency to crack into minute molecules (whenever such oils are subjected to heat) – mainly into ethylene (C_2H_4), but perhaps also into methane (CH_4), since all hydrocarbons have a tendency to disintegrate into methane, the most hydrogenous of all hydrocarbons.

For the hexane (C_6H_{14}) content of fuel oil, Von Wartenberg gives the combustion formula:

$$C_6H_{14}+6H_2O = 6CO+13H_2 \quad\ldots\ldots 12)$$

and for benzol (C_6H_6), which is also found in fuel oil in small quantities:

$$C_6H_6+6H_2O = 6CO+9H_2 \quad\ldots\ldots 13)$$

All fuel oils of a paraffinic base contain also aromatic hydrocarbons, although in small quantities. The combustion process of these consists of extremely complicated mechanisms, Fischer[7] mentions xylol (C_8H_{10}) as an example, the molecules of which enlarge under heat and form temporarily toluol (C_7H_8), benzol (C_6H_6), ethylene (C_2H_4), methane (CH_4), etc. After this, the molecules enlarge and discard hydrogen (H_2), and form diphenyl ($C_{12}H_{10}$); and under constant discharge of hydrogen there are formed larger and ever larger molecules, which eventually become but great hydrocarbon skeletons.

As we understand it today, combustion or, as our chemist friends would say, pyrogenic disintegration, is essentially a process of oxidation generating and liberating heat. The oxidation itself may be analyzed as consisting of chemical transformations whereby heavy hydrocarbons such as decane ($C_{10}H_{22}$), undecane ($C_{11}H_{24}$), etc., are subjected to pyrogenous disintegration, and thence reappear as lighter hydrocarbons such as methane (CH_4), ethane (C_2H_6), propane (C_3H_8), ethylene (C_2H_4), acetylene (C_2H_2), carbonic oxide (CO), etc.; in other words, the liquid resp. gaseous oils have been transformed into an oil-gas. By heating the oil molecules for a sufficient length of time, this transformation must take place.

For hydrocarbons of the order C_nH_{2n+2} – paraffinic oil – the C-H- affiliation is stronger than the C-C- one; hence the disintegration of the hydrocarbon molecule begins here with the carbon. For aromatic hydrocarbons, on the

[3] Von Wartenberg & Sieg. D. Chem. Ges. Vol. 53, p. 2192. 1921.

[4] Bone & Wheeler. Chem. Soc. Vol. 81, p. 535, 1902, and Vol. 19, p. 191, 1903.

[5] E. V. Evans, in Chem. Age., Vol. 5, p. 36, 1921.

[7] F. Fischer, in Ges. Abh. z. Kenntn. d. Kohle, Vol. 4, p. 448, 1920.

[6] H. von Wartenberg, in Z.V.d.I., Vol. 68, p. 153, 1924.

other hand, the C-C- are strongly united; thus the splitting process begins here with the C-H- molecules. Since the C-H- molecules do not ignite as readily as the C-C- ones, it is safe to assume that the oxidation, i.e., the combustion, begins with the C-C- in so far as aromatic oil is concerned.

These considerations are of moment to the technician. Many an engine is provided with a hot-spot of some sort – to assure catalytic ignition, should the (heat) auto-ignition fail under part-load – but if fuel droplets are directed against such a hot-spot of perhaps 1,000 °F. inherent heat, the carbon molecules of paraffinic oil are stunned and split first into C-H- rather than into C-C-, with the result that the hydrogen is consumed during the combustion process, leaving unburned carbon-molecules, which then appear as soot in the exhaust. The exhaust of an engine is a perfect tell-tale of an engine's efficiency; whenever the exhaust is of a gray color, it is an indication that soot, i.e., unconsumed carbon, is present.

The ignition temperature for the numerous substances contained in the fuel oil (tables 1 and 2), as well as the substances that form during the oxidizing process, vary considerably as illustrated in table 3.

Acetylene (C_2H_2)	ignition	temp.	804. °F.
Ethylene (C_2H_4)	"	"	1000 °F.
Propane (C_3H_8)	"	"	1058 °F.
Hydrogen (H_2)	"	"	1076 °F.
Ethane (C_2H_6)	"	"	1191 °F.
Carbonic oxide (CO)	"	"	1200 °F.
Methane (CH_4)	"	"	1233 °F.
etc.			

Table 3. Ignition temperatures.

The compression temperature within the average Diesel engine may vary from 750 to 900 °F. The oxygen molecules cuddle close to the minute fuel-droplets: the heat inherent in the highly compressed and hence hot air caused ignition to commence, i.e., pyrogenous disintegration begins. The heterogeneous substances contained within the fuel-oil rush madly through a process of disintegration; unstable peroxides form, only to disappear again as quickly as they have formed. The oxidation progresses crescendo, diminuendo, until the chemical cycle is completed, until there is left but carbonic acid (CO_2) and vapor (H_2O), the end products, beyond which the chemical reactions cannot go. All of this takes place with incredible speed. If we can visualize an engine speed of 4,000 rpm., where these extremely complicated chemical reactions must be completed within comparatively few crank degrees, or during a time interval of but a very fraction of a second, then we begin to appreciate its magnitude and the almost supernatural speed with which this takes place.

Thus we see that the Diesel engine, while a so-called internal combustion engine – or, technically speaking, an isothermic prime mover – is essentially but a chemist's retort, where a combination of carbon, oxygen and hydrogen form a very large number of gases differing widely in character, but all of them finally reducing themselves into but two substances, namely, carbonic acid and vapor. And if, on the other hand, an engine's exhaust also contains carbon (C) and carbonic acid (CO), then ill-chosen design or a frustrated combustion process – which is but man's interference with nature – has prevented an engine from fulfilling its perfectly normal and natural mission.

Editor's note: It will be appreciated if our readers will write us regarding this article—it is the "heaviest" we have yet published and your opinions will be helpful.

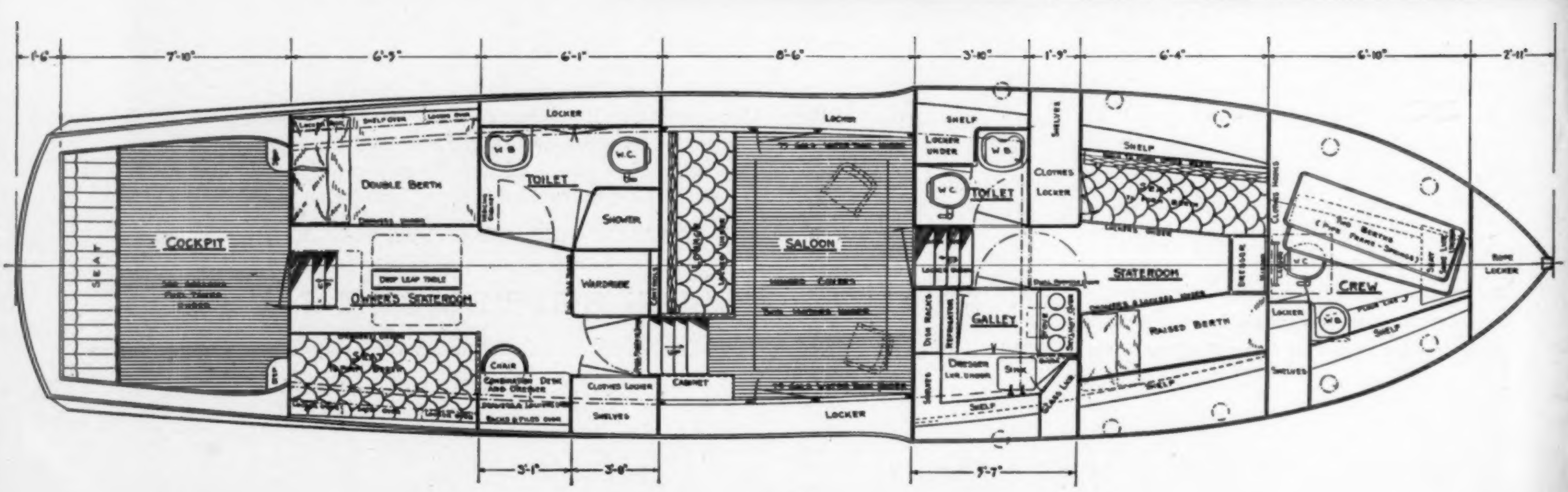
"HOPE III"

Dawn Diesel Cruiser, Deluxe

When Dr. Warren Hildreth of Southampton, Long Island, returned from the South this spring, he had some very favorable first-hand Diesel information to report. Since taking delivery of his 52-foot Dawn cruiser, *Hope III*, late in the fall of 1936, he had compiled an accurate log for 5,000 miles of pleasant and highly successful Diesel operation, or an average of 1,000 miles per month! His boat is powered with a pair of 100 hp. Superior Diesel engines which showed consistent fuel consumption of one-half gallon per mile. With a fuel cost for a 200 hp. yacht of approximately three cents a mile, it is little wonder that Dr. Hildreth is enthusiastic about this type of propulsion.

It was just about two years ago this summer that Mr. C. M. Robinson, President of Dawn Cruisers, Inc., installed his first pair of Superior Diesels in the *Aldoma*, a Dawn 45-footer, which had previously been gasoline powered. The extremely satisfactory results of that conversion were presented at length in the September, 1935, issue of Diesel Progress and the boat itself is undoubtedly well known to many of our readers. If importance at this time is to note Mr. Robinson's predictions then and their fulfillment now, two years later. After testing the *Aldoma* with her new engines, he said, "These Diesels give better performance in every way than gasoline engines ever could. Gasoline engines for cruisers will be obsolete in a few years." Since that time, 80 PER CENT OF ALL NEW DAWN CRUISERS HAVE BEEN DIESEL! In addition, the Dawn yard has also converted a number of existing cruisers from gasoline to Diesel. Such a record is consistent with the progressive policy which governs the design and construction of the entire Dawn line. It also reflects most creditably upon American Diesel manufacturers who have produced engines capable of meeting the exacting requirements of medium sized pleasure boat owners. Some years ago these qualities were set down by an authority on standardized cruisers as follows: "The Diesel engine which will meet yachting requirements successfully must be small, light and powerful. It must operate without vibration or unpleasant exhaust odor. To gain these essential features, there must be no sacrifice in dependability, flexibility or lasting qualities. In short, it will be the aristocrat of Diesel engines."

The day is here when such a prophetic description is accepted fact and yachtsmen everywhere are specifying this type of power. It cuts fuel cost in half, doubles cruising range and eliminates the danger of fuel vapor explosion in the bilge. The modern yacht is Diesel!



The flying bridge is a distinctive "Dawn" feature and leaves the forward saloon completely free for activities other than navigation and control.

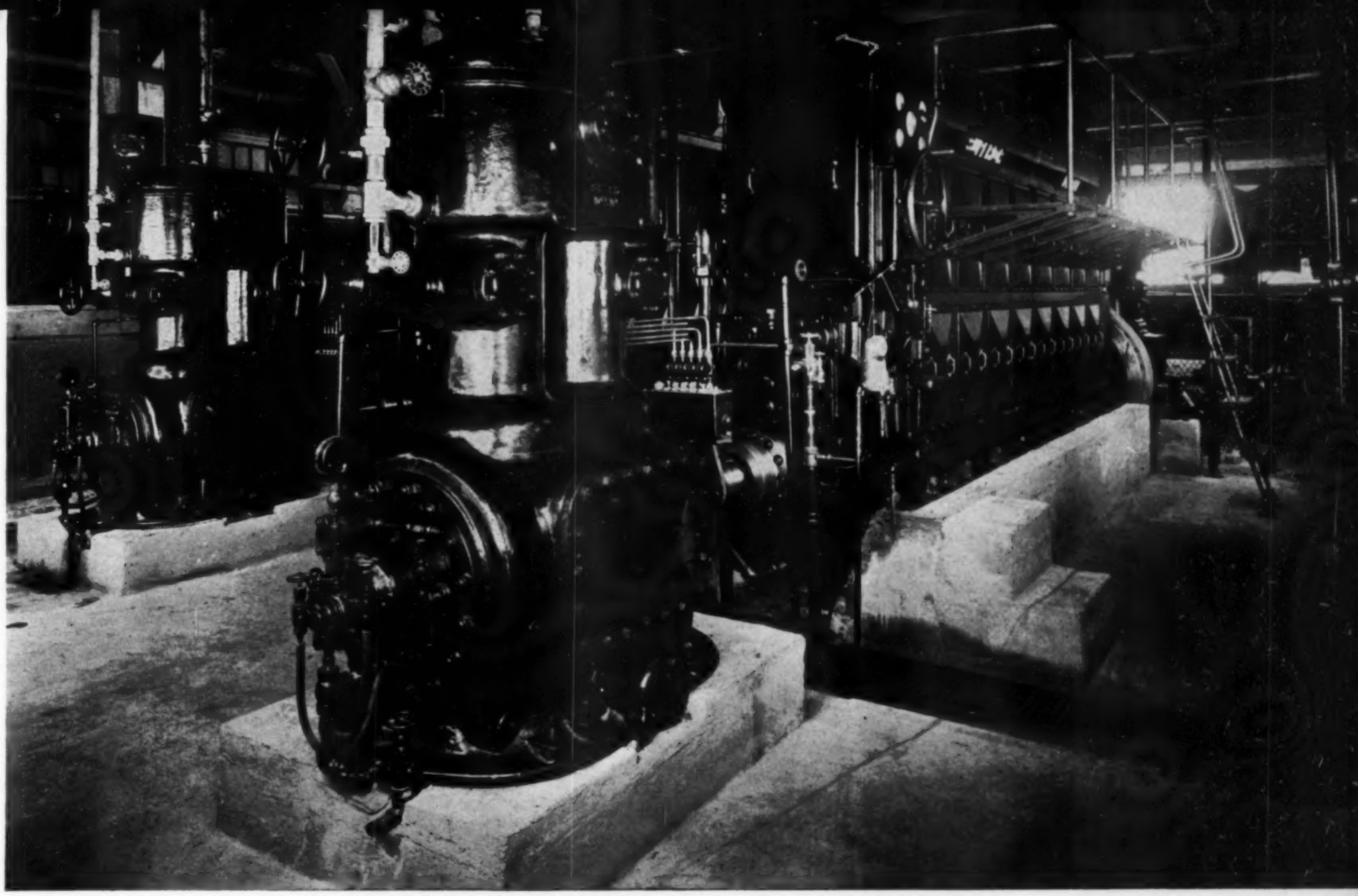
Interior photographs by Rosenfeld, coupled with the plan on the preceding page, show clearly the spacious accommodations for owner and guests.

DIESELS BREAK RAIL ROUTE ACROSS MEXICAN DESERT

THE three Caterpillar Diesel tractors at work on this page are owned by the F. C. Fuentes Brotantes-Puerto Penasco and are engaged in the arduous task of building a railroad across the Sonora Desert in old Mexico. When completed, this new line will extend for 196 kilometers from Lower California to the Northern District. Probably its chief importance to the United States is the fact that it will provide a direct rail outlet to the sea for produce from Arizona.

The units above are a Diesel powered elevating grader pulled by a Diesel RD-7 tractor. The illustration demonstrates clearly the efficiency of this sand moving combination. At the lower left is a similar tractor equipped with LeTourneau bulldozer. Its effectiveness may be noted by comparing the rough sand in the foreground with the long, smooth trail behind. Lastly comes the third tractor towing a Caterpillar No. 66 grader. There are few, if any, soil conditions which cannot be handled quickly and economically with such a variety of equipment. Each engine consumes about three and one-half gallons of 9c fuel, giving an operating cost of approximately 31c per hour per unit or only one dollar and a quarter an hour for all four engines.

The combination of excessively hot weather and extremely sandy soil makes working conditions for these machines particularly difficult, which is doubtless exactly why they were selected for the job.



Two Superior Diesels of 400 and 315 hp., respectively, now furnish power for this plant. Each engine is equipt with an Alnor pyrometer visible on the gauge board.

SOUTHERN NEW ENGLAND ICE CO., Inc.

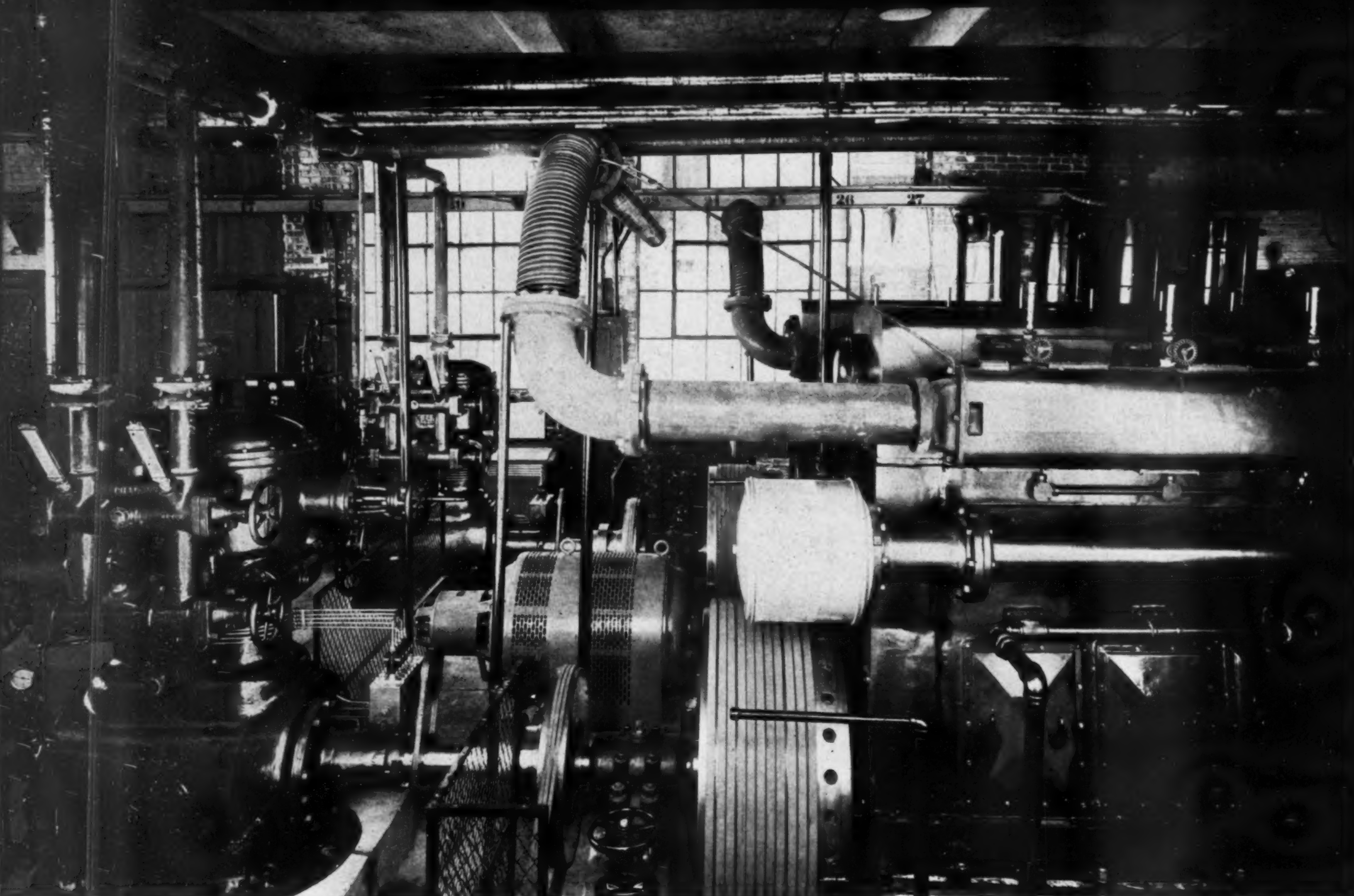
By JOHN W. ANDERSON

CONVERSION of the second largest ice making plant in Connecticut from steam engine and purchased electric power drive to Diesel drive presents an interesting case example of how such problems can be solved. This plant is located in Bridgeport, and is one of several owned by the Southern New England Ice Co., Inc., which depends partly upon natural ice and partly on manufactured ice for its supplies. The mild weather last winter greatly curtailed the supply of natural ice and this conversion has taken place none too quickly to help make up the deficiency and do it economically at the same time.

The original plant was an old timer, with one condensing type uniflow and one corliss steam engine. The crane motors and lights used direct current generated in the plant, while other motors used alternating current purchased outside. Age had not improved the operating condition and economy of the plant, and these factors brought the decision to modernize the plant and install Diesel engines to drive the ammonia compressors and generate all of the electrical power requirements.

The arrangement of the new machinery is shown in the plan. To provide this space, an old freezing tank was removed. This places the machinery adjacent to and in the same room with another freezing tank; and directly beneath a newer tank on the second floor. The engine room floor is at the same level as the bottom of the freezing tank. On the other side of the engine room is a covered yard housing one of the ice loading platforms and truck storage space. There are two Diesel engine compressor units with a single generator between them. One unit is a 420 bhp., 8 cylinder, 12½" by 15", 300 rpm., four cycle, solid injection, Superior Diesel engine, driving through Fast couplings from each end, a 10" by 10" Frick compressor. The other unit is a 315 bhp., 6 cylinder, 300 rpm. Superior Diesel of the same type and cylinder size as the first unit, and it drives two more compressors of the same size and in the same manner. The engine speed was chosen to suit the compressors. By disconnecting the couplings, any number of compressors from one to four can be operated according to the refrigerating requirements, and in addition the engine speed is variable. This gives a very flexible setup to meet every variety of conditions.

The Diesel engines are of the standard Superior design. The common rail fuel injection system is used, and the injection pressure pumps are located at the control end of the engine unit.



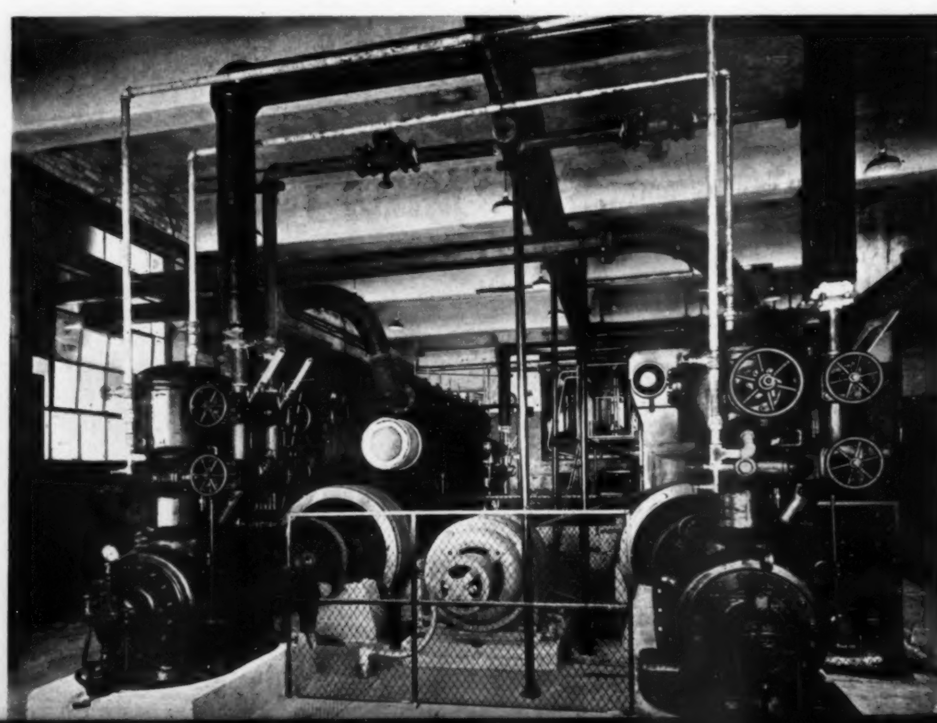
View looking across the engine room. Note the V-belt drives from the two flywheels to the Crocker-Wheeler generator between. The lower illustration shows this arrangement to better advantage. The Burgess intake air filter on the engine header also appears prominently.

Dual valves in the cylinder heads are operated by rocker arms from the overhead camshaft located along the side of the engine, all of this valve gear is fully enclosed and is lubricated from the engine pressure system. All parts of the engine are readily accessible by removing the appropriate covers. The engine controls and the gauge board are conveniently concentrated at the control end of the engine opposite the flywheel. At this end, the crankshaft is extended to take the coupling for driving one of the compressors, while at the flywheel end the extension shaft extends beyond the outboard bearing, which takes part of the flywheel weight, to carry the drive for the circulating water pump and for the coupling for the other ammonia compressor.

The generator is a 156 kva., 125 kw. at 80 per cent power factor, 3 phase, 60 cycle, 480 volt, 1200 rpm. Crocker Wheeler machine with a 3 kw. direct connected exciter. This generator is mounted on a sliding base with a wide range of adjustment. The drive can be taken from the flywheel of either engine as desired, and there are two sets of 11 V belts for this purpose. The set not in use is fastened up out of the way. The set in use runs on the grooved pulley of the generator and around the flat surface of the engine flywheel. It takes only a few minutes to change over from one engine to the other.

The switchboard and all of the engine accessory equipment are along the engine room wall at the side of the eight cylinder engine unit. The switchboard is a Roller Smith dead front type with Allis-Chalmers rocking contact type voltage regulator, ammeters, voltmeter, kilowatt hour meter, exciter switch and fused main field switch.

When excavating for the machinery foundations it developed that a small creek had originally run diagonally across the site of the engine room. Before the original plant was built, the water had been diverted and the creek filled in. To avoid any possibility of trouble from



this source, it was decided to spread the area of the foundation for the Diesel engines. The normal depth of 6 feet for the foundation was retained because tests showed that the water level was 10 feet below the ground level. The single foundation block for both units contains 155 cubic yards of concrete, and rests on the sand and dirt fill of the creek bed and the adjacent ground. This solution was entirely successful, and there is no perceptible vibration even on the foundation block.

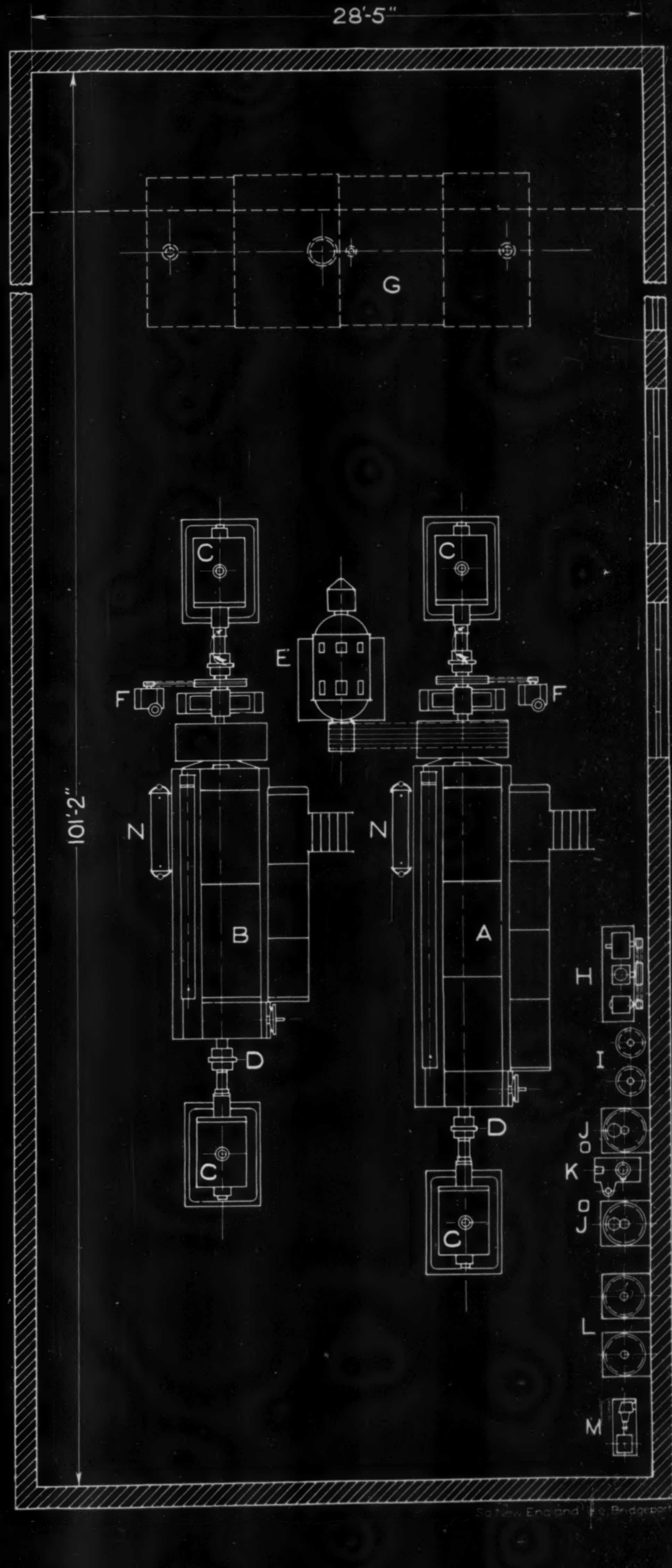
The air intake for the engines is from the engine room through the Burgess filter mounted right on the end of the intake header on the engine. The exhaust is from the engine header through a section of flexible piping, out overhead through windows at the side, and into the Maxim silencer and tail pipe beyond, that point upward through the roof of the shed over the adjacent loading platform. The silencer and tail pipe are supported by brackets on the wall. The silencer itself which passes through the wooden roof of the shed, and the wood is carefully protected from the heat.

Fuel is stored in the 5,000 gallon tank that is buried under the floor at one end of the engine room as shown on the plan. Number 2 fuel is used and it is delivered by truck. The truck comes into the adjacent loading yard and a hose is run through the engine room door to the tank filling connection. This Company is in the fuel business as well as the ice manufacturing business and uses its own fuel and own trucks for the purpose.

There are three ways of getting fuel oil up to the engine day tanks on the wall. Normally a plunger pump on the end of each engine takes its suction from the storage tank and delivers to that engine's day tank. The overflow constantly runs back to the storage tank and the day tank is always full. If this pump should fail, there is a motor driven fuel transfer pump which will deliver to either day tank. There is also a hand pump available as a last resort.

Legend

- **A. Eight cylinder, four cycle, 420 bhp., 300 rmp., Superior Diesel engine**
- **B. Six cylinder, four cycle, 315 bhp., 300 rpm., Superior Diesel engine**
- **C. 10" by 10" duplex ammonia compressor**
- **D. Flexible coupling**
- **E. 156 kva., 125 kw., 3 phase, 60 cycle, 480 volt alternator with 3 kw. direct connected exciter**
- **F. Circulating water pump**
- **G. 5,000 gallon fuel storage tank**
- **H. Starting air unit**
- **I. Starting air tanks**
- **J. Lubricating oil wall tanks**
- **K. Lubricating oil centrifugal purifier**
- **L. Fuel oil day tanks**
- **M. Motor driven fuel oil transfer pump**
- **N. Lubricating oil cooler**
- **O. Nugent lubricating oil filters**



From the day tank, the fuel flows by gravity through a meter to the injection pumps on the corresponding engine. There are twin fuel filters mounted on the engines.

Each engine has its own lubricating oil system. The pump on the engine is a double one combined in a single pump unit. One section of the pump keeps the crankcase sump dry and delivers the oil through the Nugent filter unit mounted on the wall under the wall tank, to the wall tank higher up on the wall. The other section of the pump unit takes its suction from this wall tank and delivers to the lubricating oil header in the engine. On the engine room floor underneath these wall tanks, there is a Goulds Hydroil centrifugal purifier. It is the practice to use this purifier on the oil for each engine for twelve hours per day. It is found that this keeps the oil in good condition and the purifier bowl must be cleaned of sludge once a day.

Each engine has its own cooling water circuit and the water for it is taken from and returned to the ammonia condenser cooling system. These ammonia condensers are located near the end of the engine room and the tank under them is at the level of the top of the freezing tank, and this level is several feet above that of the engine room floor. Consequently there is a positive suction head on the engine circulating pumps located at the engine room floor level. These pumps are of the centrifugal type and each engine has its own pump which is V belt driven from the engine extension shaft as shown on the plan. The pump delivers through the engine jackets and back to the ammonia condenser tanks. This arrangement gives a good circulation of water at the proper temperatures.

The water for the ammonia condenser system is cooled by circulating it up over the cooling tower on the roof. This cooling tower was also formerly used for condensing water for the steam engines and is of considerable capacity. Large motor driven centrifugal pumps circulate this water, drawing from the tank under the condensers and sending the water to the top of the tower, from whence it flows down through the tower and the condensers back to the tank under the latter. In addition, a certain amount of cold water is taken from the wells on the property and fed into the system as makeup. The amount fed as makeup is more than sufficient to take care of the losses from evaporation, and there is always some overflow of the warm water to the sewer. This of course helps the cooling tower maintain the proper temperatures.

Starting air is supplied by a 15 cubic feet per minute capacity two stage air cooled Curtis compressor mounted on a common base with a 3 hp. motor and a 3.7 hp. Wisconsin gasoline engine. Either the motor or the gasoline engine can be used as the source of power, and the drive to the compressor is by V belt. Starting air is stored in two tanks each measuring 20″ diameter by 96″ long.

The Diesel engines have a full quota of instrument equipment. Each unit has, besides the usual pressure gauges and thermometers, a Reliance tachometer, Alnor pyrometer equipment with the pyrometer dial on the gauge board, and automatic alarm equipment. The latter rings an alarm in case of high cooling water temperature or low lubricating oil pressure. While there is a cutout for the latter for use during the starting period usually the alarm continues to ring until the pressure builds up to the minimum figure.

The old freezing tank crane is available for handling the engine parts during the overhaul periods. It was not necessary to make any changes in this part of the equipment because lowering the engine room floor gave sufficient head room for the engines under the existing crane. The motor for this crane is a direct current machine, and this was retained, while a small motor generator set was added to supply energy for it. All other direct current electric motors in the plant were changed over to 3 phase, 60 cycle, 440 volt alternating current.

Flexibility of operating capacity has already been mentioned. It is planned to operate both engines and all compressors from May to October. During this period, the generator would be driven by the eight cylinder engine unit. The refrigerating compressors are rated at 46 tons capacity each, so that the full plant capacity is about 150 tons of ice per day, and there are three large ice storage rooms which must be kept chilled. The minimum capacity of the plant is in the winter time when the six cylinder engine is driving one compressor and the generator. The engine driving the generator must run at its full rated sped at all times in order to maintain the proper electrical frequency, but the other engine unit can be varied in speed as desired. These units have been tested at variable speed and not a trace of a critical speed exists anywhere from zero speed right up to the full speed of 300 rpm.

The choice of two engines of the same cylinder size but with a different number of cylinders gives two direct advantages. There is an interchangeability of spare parts and the stocking of such needs is simplified; and the arrangement permits of getting a good load factor on the individual engines during operation, with a resulting improvement in operating economy. In warm weather when the full capacity for ice making is needed and there are high head pressures on the ammonia compressors, the greatest engine powers are required, and the 8-cylinder engine has two extra cylinders for carrying the generator load. In cold weather when only one compressor is needed, the generator is on the 6-cylinder engine, and together with the compressor load, there is a good load factor for this engine. In between these extremes, the generator would usually be driven by the 8-cylinder engine, but in an emergency the 6-cylinder engine can always drive the generator and compressors by drawing upon its reserve power capacity.

The engine room width of 28 feet 5 inches gives ample space between and around the engines and the generator, as well as for the auxiliaries along the side wall. While the machinery arrangement calls for a room considerably longer than its width, the length given on the plan comes from the existing building dimension. It was this available and otherwise unused extra length that gave the idea of placing the fuel tank under the floor at the end of the room. It could have been just as well located in the loading yard alongside for instance, because in either case the necessity of protection against fire would place the tank underground. The height of the room proved to be comfortably sufficient to provide the required head room for lifting out the pistons, under the existing crane. In case this had not been so, the floor level could have been dropped a bit when putting in the new foundations.

The layout of the plant with the two main units alongside of each other and the accessory equipment grouped along the wall gives a naturally neat appearance. While the exhaust pipes and ammonia pipes are carried overhead, nearly all other piping is placed in trenches under the floor and covered with the usual diamond tread floor plate. The operating personnel keep the plant and machinery very clean, and its appearance will be further enhanced when the final painting is finished.

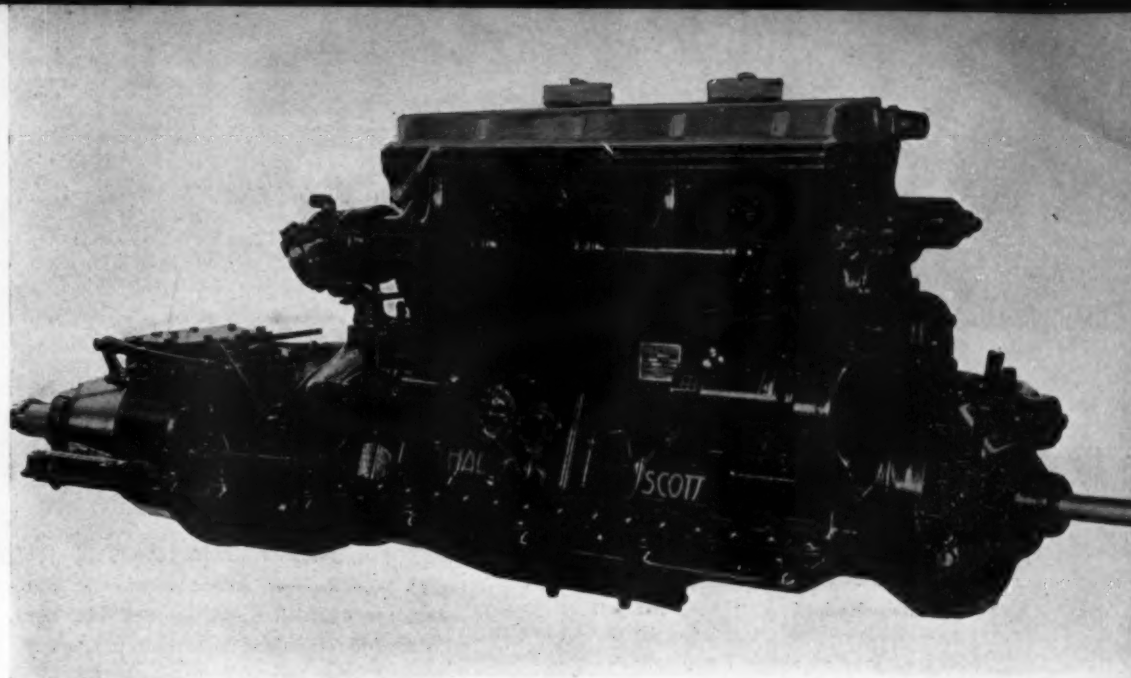
This plant was placed in operation about the first of March and the time since has been too brief to accumulate very much operating data, but a few figures are available. The eight cylinder engine uses about two gallons of lubricating oil per day of twenty-four hours. The six cylinder engine uses about a gallon and a half in the same time. With both engines and all four compressors running, fuel consumed runs about 700 gallons per day, but this includes the generation of 1,700 kilowatt hours of electrical energy, as well as the production of ice and the refrigeration of the storage rooms. The operating results have fulfilled every expectation of dependability, capacity and economy.

There is one engineer and an ice puller on duty during each watch. The plant changes were made under the supervision of Ralph G. Hadley, who is Vice President and General Manager of the Company, with main offices in Hartford, Conn. John Y. Boyce is the Superintendent.

This installation is visual evidence of the advantages to be gained by modernizing these old time ice making plants. It shows that it can be done, and also how it can be done.

It is our hope that, by presenting this picture of Diesel modernization of a typical ice plant, other owners of similar plants may investigate the possibilities of Diesel conversion.

PACIFIC TUG "LEADER" REPOWERED



THE tug boat *Leader,* owned by the Red Salmon Canning Company of San Francisco, Calif., sees service every year at Bristol Bay in Alaska. Built in 1918 by the Lester Stone Boat Works of Oakland, Calif., this boat is of heavy construction and has a net weight of 17 tons and a gross of 42. It is 65'3" long with a beam of 18 feet and draft 6'6". The old, so-called slow turning, heavy duty gas engine had served its purpose, had become too costly to run, therefore a Hall-Scott "Chieftain" was selected to repower the *Leader.*

The old, slow turning 110 hp. gas engine weighing more than 8 tons gave the *Leader* a maximum speed of 8.1 knots running light. It handled a 56" x 44" propeller turning with direct drive a maximum of 250 rpm. This engine was hoisted from the boat after the cabin had been removed.

Before installing the "Chieftain," the Geo. W. Kneass Company, boat builders of San Francisco, overhauled the hull and added two extra bunk houses sleeping four additional passengers, thus utilizing space formerly occupied by the old engine.

The "Chieftain," weighing 4090 lbs. equipped with Hall-Scott built-in 7:1 reduction gears, was installed. The initial cost of this engine was approximately 50 per cent less than a large slow turning engine which would occupy more than twice the space and weigh from 6 to 8 tons more and develop the same horsepower.

Trials were run using the same propeller (56" x 44") and the peak rpm. was well above 1800. A larger propeller was required, therefore a new wheel with larger blade area measuring 56" x 55" was installed. Limited hull clearance prevented the installation of a larger diameter wheel.

Final trials established a top speed of 9.6 knots with the engine turning 1750 rpm. maximum and the propeller peaking at 250 rpm. When towing a 65-foot gravel barge the *Leader* attained a top speed of 6.5 knots. The 110 per cent rpm. in reverse, which is obtainable with all Hall-Scott reduction gears, gives excellent maneuverability under all operating conditions.

Leaving San Francisco Bay under her own power, destination Bristol Bay, Alaska, the *Leader* bucked heavy seas on the first lap of her trip to Seattle. Her average speed during the 144-hour run from San Francisco Bay was better than 6 knots with the engine turning 1400 rpm., propeller 200 rpm., to give 7 knots under normal operating conditions.

This gave a total of 171 hours on the engine when it reached Seattle, including the trial runs made on San Francisco Bay before her departure. Lubricating oil consumption during this time amounted to 1½ gallons. Consumption of fuel oil averaged 3.6 gallons per hour.

From Seattle the *Leader* towed a new Hall-Scott powered power scow on the second lap of her trip to Ketchikan, Alaska. The run from Seattle to Ketchikan was made in 133½ hours with an average speed of 5¼ knots towing.

The Hall-Scott "Chieftain" has definitely demonstrated its ability to handle heavy tug boats on this trip when running light and under load. The exceptional fuel and lubricating oil economy, the low initial cost of this engine, the fact that it occupies less space and does away with excess weight, combine to prove the wisdom of choosing a marine Diesel.

ITALIAN DIESEL RAILWAY NOTES

. . . . Continued from page 39 . . . .

Six Diesel engined rail cars for the Spain North Railways fitted with two 145 hp. Diesel engines of the Fiat system with 82 seats and 1,675 mm. gauge of the following dimensions:

Length	23.280 mm.
Breadth	2.350 mm.
Weight (empty)	26 tons
Weight (loaded)	36 tons
Maximum speed	105 km/hr.
Consumption	700 gr/km.

Six rail cars as above for the Spain M.Z.A. Railway.

Five double car rail cars for the Central Brazilian Railway, with the following dimensions:

Length	30.400 mm.
Breadth	2.700 mm.
Gauge	1.600 mm.
Diameter of four wheels	720 mm.
Weight (empty)	44 tons
Weight (loaded)	54 tons
Maximum speed	85 km/hr.
Two Fiat engines of 145 hp.	290 hp.
Consumption	750 gr/km.

These rail cars, which have some resemblence with the Italian streamlined trains, have accommodations for 80 passengers, and are provided with bar service and with air conditioning plants.

It should be considered that on all these orders which have gone to the Fiat in Turin the same Diesel engines as in the Italian State Railways rail cars have been employed.

In this connection it may be added that the Italian State Railways Administration has just ordered further 80 Diesel engined rail cars with the following dimensions from the Società Italiana Ernesto Breda in Milan, as they are contemplating the extension of the rail car services also on the Trieste- Pola line, on the Treviso-Vicenza line, etc.:

Length	21.000 mm.
Weight of the car ready to start	22 tons
Carrying capacity of passengers and luggage	6 tons
Two Diesel engines of 130 hp. each	260 hp.
Seats	56
Maximum speed	140 km/hr.

In addition to the Italian State Railways Administration, private owned railways also have ordered Diesel engined rail cars in order to settle their traction difficulties, and among them may be mentioned the Ferrovie Meridionali Sarde, the Ferrovie Complementari Sarde, the Ferrovia Circumetnea (round the Etna Volcano) and certain lines in Northern Italy. In practically all these cases engines from 80 to 115 hp. each have been employed, even when the normal length of the cars, varying between 12 and 17 meters in general, has reached 22 meters, as in the case of the rail cars ordered for the Suzzara-Ferrara railway having a carrying capacity of 78 seats with a weight of 32 tons at full load. These have been the largest rail cars built for Italian private owned railways.

CORRECTION

WE are pleased to acknowledge a correction in the London Letter No. 20, appearing last month, called to our attention by the Associated Equipment Co., Ltd., Middlesex, "the Diesels for motor yacht 333 were specially designed as marine power units," instead of being "modified road vehicle engines."

NEW MOTION PICTURE DRAMATIZES INDUSTRIAL LUBRICATION

A UNIQUE motion picture dramatization of lubrication methods in modern industry, one of the most comprehensive studies of its kind ever attempted, was shown for the first time recently in the preview theatre of Radio City Music Hall, Rockefeller Center, New York.

More than 100 representatives of the trade press saw the first public screening of the new film as guests of P. M. Gordon, Manager of the Industrial Department of the Socony-Vacuum Oil Company, producers of the picture.

The new film is done in a "March of Time" style. Unusual animated drawing and striking photography are used to illustrate correct lubrication of various types of machinery.

The picture is called "The Inside Story." A microscopic film of oil assumes the hero's role in this industrial drama. But for this film of oil, the picture points out, many of the common daily conveniences of modern life, now within the reach of millions of people, would never have been possible.

Socony-Vacuum's reproduction of Dr. Diesel's laboratory and first engine. The two following illustrations show (1) what happens inside a Diesel cylinder and (2) a microphotograph of a highly polished bearing and journal indicating the vital need for proper lubrication.

The story of the fundamentals behind correct lubrication is told by showing bearings, gears and cylinders — the essential elements of all machines — and demonstrating how they operate, how they are lubricated and the lubrication needs of various types.

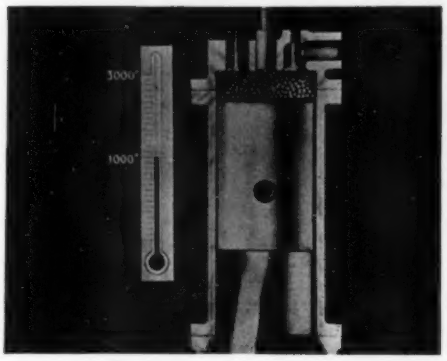
After a quick review of the field of industrial and mechanical progress, presented in effective photomontage, the film demonstrates the need of lubrication to protect moving parts. The spectator sees the results of friction when two highly polished surfaces move on each other. Microphotographs, enlarged until they cover the whole screen, show the reasons for friction, the fact that even highly polished surfaces are covered with hills and dales which the unaided eye cannot see.

Various bearings are then shown and an animated drawing shows just what goes on inside, how lubrication prevents metal to metal contact. Factors to be taken into consideration in the selection of the proper lubricant are fully explained.

In a similar way, the lubrication of gears is illustrated with animated drawings showing how a gear transmits power and how the lubricant provides protection.

Another series of pictures shows the work that correct lubrication does in protecting the moving parts of various prime motors — the Diesel engine being selected as an example. Animated

drawings make clear the principle upon which the engine operates and the manner in which explosions are translated into usable power. Further drawings illustrate what a lubricant must do if efficient operation is to be maintained.



The new film will be shown to business organizations and to groups of plant managers and factory executives in industrial communities throughout the country, according to Mr. Gordon. "Production of this film is the answer to a growing demand among plant managers for a simple, complete and straightforward discussion of the subject of industrial lubrication," Mr. Gordon declared.

"For many years it has been the company's practice, as leaders in the field of industrial lubrication, to keep engineers on the road, visiting various industrial plants, and giving illustrated lectures on the lubrication problems which confront plant managers. With industrial expansion, newer types of machinery and increased production, the demand for this type of service is growing rapidly. The new film represents the most modern and effective way of presenting the subject and permits us to reach a much larger audience than heretofore.

"It is expected that 'The Inside Story' will go a long way toward making the whole mater of correct lubrication more clear to the plant man who depends upon it for his daily livelihood, or the plant owner looking for increased profits from the business in which he is engaged."

S. A. E. NEWS

TWELVE companies have indicated a desire to buy one of the universal single-cylinder test engines now being developed by a volunteer Society of Automotive Engineers Committee group with the cooperation of the Waukesha Motor Co.

The test engine will be adaptable to work on Diesel cylinders, Diesel fuels, piston-rings, spark-plugs, small-bore cylinders, oil testing and development, aviation fuels, and to the addition of various engine accessories.

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An inspection trip through the plant of the Electro-Motive Corp., where Diesel-electric locomotives for streamlined trains are built, is planned as a feature of special interest to Diesel men at the SAE Section Regional Transportation Meeting to be held in Chicago, September 29-October 1. Papers scheduled for this meeting will discuss truck ratings, E. P. lubricants, heating and ventilating of buses, and steam railcars.

• • •

J. H. Pitchford, co-author with H. R. Ricardo of the paper: "Recent Trends and Developments in European Automotive Diesel Engine Design," which he presented at the 1937 SAE Summer Meeting, has returned to England after visiting American Diesel plants and laboratories from coast to coast. The paper of these two British Diesel authorities will appear in an early issue of the SAE Journal.

• • •

Two Wisconsin University professors about a year ago completed development of a Diesel indicating apparatus capable of great accuracy at high speeds and of producing a large number of records to compensate for variations in successive cycles of engine operation. Later they put it to work in making an exhaustive study of the behavior of high and low-cetane fuels. They give the results in an August SAE Journal paper. They show how a high-cetane fuel can produce just as rough Diesel operation as one of low cetane value if timing is too early—and how a low-cetane fuel can give smooth operation if injected late enough during the compression stroke of an engine with a high compression ratio. The two professors are G. C. Wilson and R. A. Rose.

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Five SAE members will present papers on vital Diesel topics at the Oil and Gas Power Meeting of the A.S.M.E. scheduled for August 18-21, at State College, Pa. At the Fuels and Lubrication Session on August 19, C. G. A. Rosen and W. F. Joachim will discuss Diesel lubricating problems and fuel oils, respectively. Automotive Diesel engines will be covered by O. D. Treiber and Diesel-electric buses by Martin Schreiber in the Transportation Session on the same day. In the concluding Research Session, Gustav Egloff will have polymerization of fuel oils for his subject.

W. E. LERCH

W. E. LERCH, chief engineer of the Hemphill Diesel Schools, is now on an extensive research and inspection tour of Europe. Throughout his tour Lerch will consult with leading Diesel engine builders and engineers in a comprehensive study of the latest Diesel developments abroad.

Having sailed July 17 on the motorship *Pilsudski* for Copenhagen, Lerch began his tour in Denmark, where he visited the Burmeister and Wain and the Frichs Diesel engine plants and inspected several of the large marine and stationary installations in that country. From Denmark Lerch was to go to Sweden for visits to the Atlas Diesel Co., Ltd., and the Bolinder plant. Next on his itinerary were leading German plants, including the Hanomag Hanoversche Maschinenbau A/Z, Hanover; Freidrich Krupp A/Z, Essen; Deutz Humboldt Motoren A/Z, Cologne; and the Benz plant, at Mannheim.

After a vacation in Switzerland, Lerch's program includes visits to additional German plants and thence to leading Diesel establishments in Austria, Hungary, and France. The final leg of his trip may be a tour of various English plants, including the Okill Indicator and the Victor Oil Engine factories. Lerch expects to return some time in October.

NEWS

IMPORTANT news!!! The William K. Gregorys are expecting a blessed event on or about August first. As the "American Air Filter Man," Bill Gregory is known from one end of this industry to the other—and mighty favorably so. Many of our readers remember the lively reception given to Mr. & Mrs. Gregory when they spent their honeymoon at the Nittany Lion Inn three years ago when the Oil & Gas Power Division of the A.S.M.E. was in convention at State College.

GEORGE W. CODRINGTON

GEORGE W. CODRINGTON, President of the Winton Engine Corporation of Cleveland, Ohio, who has been a dominant factor in the Diesel Industry for the past fifteen years, was recently elected a member of the Board of Directors of the Electric Boat Company and attended his first board meeting on July 6th. The significance of his election to the board of the Electric Boat Company has created a considerable amount of conversation throughout the industry, but no definite statement has so far been obtainable either from Mr. Codrington or from Mr. H. R. Sutphen, Vice-President of the Electric Boat Company.

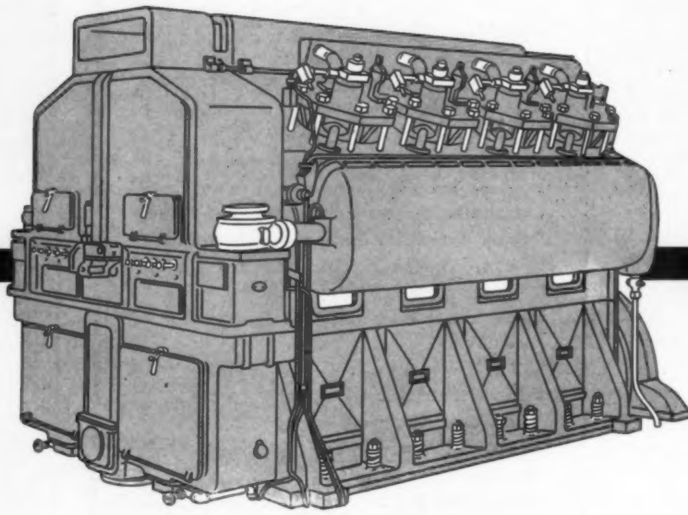
WILLIAM J. DAVIDSON

APPOINTMENT of Mr. William J. Davidson, of Detroit, as General Sales Manager of Winton Engine Corporation, effective July 1, is announced by Mr. G. W. Codrington, President of Winton Engine Corporation. Mr. Davidson has been Technical Director under Mr. R. H. Grant, Vice-President of General Motors Corporation in charge of sales.

DIESEL PROGRESS

INDEX OF ADVERTISERS

...for reducing weight of Diesel engines



ALCOA ALUMINUM

Diesels need no longer struggle under a burden of excess weight. The pounds-per-horsepower today of some types is only slightly above that of gasoline engines. Many engine manufacturers have accomplished this weight reduction through liberal use of Aluminum.

The per-pound cost of saving weight with Aluminum used in conventional construction is lower than is practicable by using conventional materials and other forms of construction.

The natural lightness of Aluminum makes it ideal for many parts for both large and small Diesels: for example, crankcases and frames, cover plates and fittings. Casting alloys and wrought alloys have been developed by research to give these parts the sturdiness, strength and durability required for heavy duty, continuous service.

In other parts of the Diesel engine, the superior heat conductivity of Aluminum is helping to improve performance, assuring greater reliability and economy. Uniform distribution of heat in Aluminum pistons and cylinder heads minimizes thermal stresses which so often are responsible for failures. Aluminum Company of America, 2141 Gulf Building, Pittsburgh, Pennsylvania.

Be sure ... SAVE WEIGHT WITH

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